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A. C. TRUE, Director.

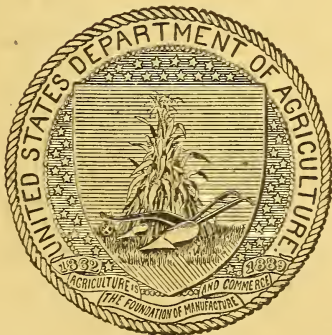
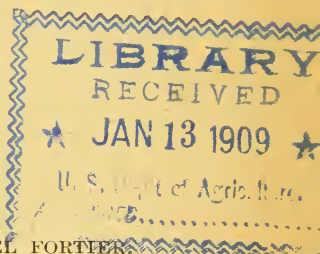
IRRIGATION IN WYOMING.

BY

CLARENCE T. JOHNSTON,

State Engineer.

PREPARED UNDER THE DIRECTION OF SAMUEL FORTIER,
CHIEF OF IRRIGATION INVESTIGATIONS.



WASHINGTON:
GOVERNMENT PRINTING OFFICE.

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LIST OF PUBLICATIONS OF THE OFFICE OF EXPERIMENT STATIONS ON IRRIGATION.

NOTE.—Publications marked with an asterisk (*) are not available for distribution.

BULLETINS.

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- *Bul. 58. Water Rights on the Missouri River and its Tributaries. By Elwood Mead. Pp. 80.
- *Bul. 60. Abstract of Laws for Acquiring Titles to Water from the Missouri River and its Tributaries, with the Legal Forms in Use. Compiled by Elwood Mead. Pp. 77.
- Bul. 70. Water-right Problems of Bear River. By Clarence T. Johnston and Joseph A. Brockons. Pp. 40.
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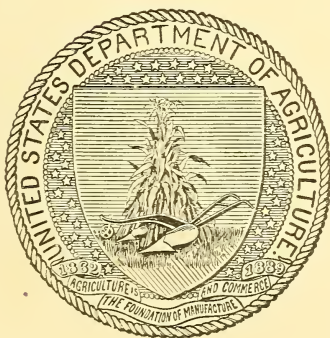
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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., October 1, 1908.

SIR: I have the honor to transmit herewith a report on irrigation in Wyoming, prepared by Clarence T. Johnston, State engineer of that State. This is one of a series of reports giving the present status of irrigation in the several arid States. There is a very large call upon this Office for general information regarding the opportunities for settlement on irrigated lands in these States, the cost of land and water, and of establishing homes on these lands and regarding the crops grown. The attempt has been made to include in each of these reports as nearly as possible all the information which will be needed by parties contemplating settlement in the State to which it refers. It is recommended that the report be published as a bulletin of this Office.

Respectfully,

A. C. TRUE,
Director.

HON. JAMES WILSON,
Secretary of Agriculture.

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IRRIGATION IN WYOMING.

INTRODUCTION.

Wyoming is located centrally among the States of the Rocky Mountain region. It lies between Montana on the north and Colorado and Utah on the south, with South Dakota and Nebraska on the east and Idaho and Utah to the west. It is 355 miles in length east and west by 276 miles north and south. It has an area of 97,890 square miles, or 62,645,120 acres, and is greater in extent than the New England States combined with New Jersey, Delaware, and Maryland. There are within its borders lofty mountains, canyons, valleys, and plateaus and rolling plains furnishing admirable pastures for live stock. The elevation of the State varies from 3,000 to 14,000 feet, with a mean of about 6,000 feet. About one-sixth of the area of the State is agricultural land, exclusive of grazing areas, while another sixth is in forest reserves. There are several large rivers in the State, none of which is navigable as the term is usually understood. The great Continental Divide and other minor divides form the boundaries of four natural water divisions tributary to four different drainage basins. The North Platte, Powder, and Yellowstone rivers are tributary to the Missouri River, the Big Horn being a tributary of the Yellowstone; Snake River flows into the Columbia; Bear River flows into Great Salt Lake; and Green River flows into the Colorado and thence to the Gulf of California. (Pl. I, p. 10.)

Coal, iron, copper, and gold mines are increasing in value, so that mining is now becoming an important industry of the State. The oldest and largest industry is that of stock raising, though agriculture is fast becoming of equal importance.

The population of the State was estimated at 120,000 in 1907 and the assessed valuation of property at that time was \$54,429,177.98. The revenue of the State amounts to about \$600,000 per annum, of which about one-half is obtained through taxation, the rate being $5\frac{7}{8}$ mills per dollar at the last assessment.

At present there is only about \$4,000,000 invested in manufacturing establishments in Wyoming.

Oil, natural gas, soda, and Portland cement materials are among the natural resources of the State which have not been developed.

In many portions of the State the soil is especially adapted to the raising of sugar beets, and the number of acres devoted to this crop is

increasing greatly every year. It is probable that factories will be built as the acreages increase.

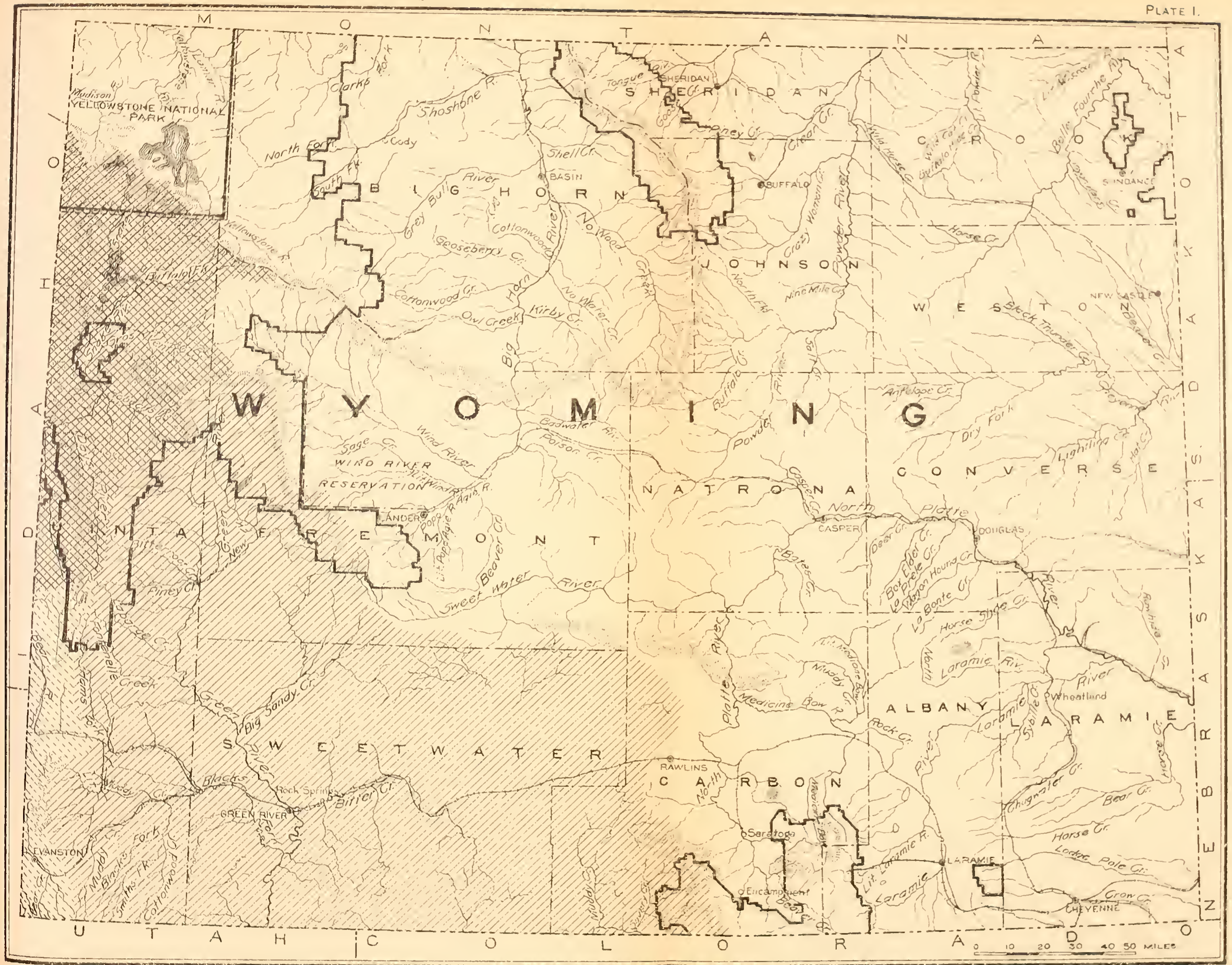
RAILROADS.

The Union Pacific Railroad, which traverses the southern part of the State, has 468.97 miles of track in Wyoming. This railroad connects with the Oregon Short Line at Green River and runs both east and south from Cheyenne. The Colorado and Southern runs 153.69 miles north from Cheyenne to Orin Junction, where it connects with the Chicago and Northwestern. This road from Chadron, Nebr., to Casper has 130.43 miles in Wyoming and is continued from Casper west to Lander, a distance of 149 miles, under the name of the Wyoming and Northwestern Railroad. Four different lines of the Burlington Railroad enter or cross the State. One line extends from Cheyenne southeast to Holdrege, Nebr.; the main line from Lincoln, Nebr., to Billings, Mont., crosses the northeastern portion of the State through Newcastle and Sheridan; there is a branch which runs south from Toluca, Mont., to Cody and Kirby in the Big Horn basin, and another from Alliance, Nebr., to the iron mines at Guernsey, Wyo. These lines make a total of 465.52 miles of railroad belonging to this company in the State. There are also several shorter roads in the State. The Colorado and Wyoming Ore Road at Sunrise is 14.55 miles long; the Laramie, Hahns Peak and Pacific from Laramie to Centennial is 30 miles long; the Saratoga and Encampment Railroad has constructed 24 of its proposed 44 miles of road, and there are in addition 6.6 miles of coal road from Belle Fourche and 19 miles of road out of Diamondville. With these shorter roads the total mileage in the State is brought up to 1,461 $\frac{3}{4}$ miles. Those portions of the State which are not immediately accessible from the railroads are reached by stage lines. Among the daily stages are those from Sheridan and Clearmont to Buffalo, and from Shoshone and Kirby to Thermopolis; from Moorcroft to Sundance; from Laramie to North Park, Colorado; from Rawlins to Baggs and Dixon; from Opal to the upper Green River country, and from Carter to Fort Bridger and points to the southeast.

CLIMATE.

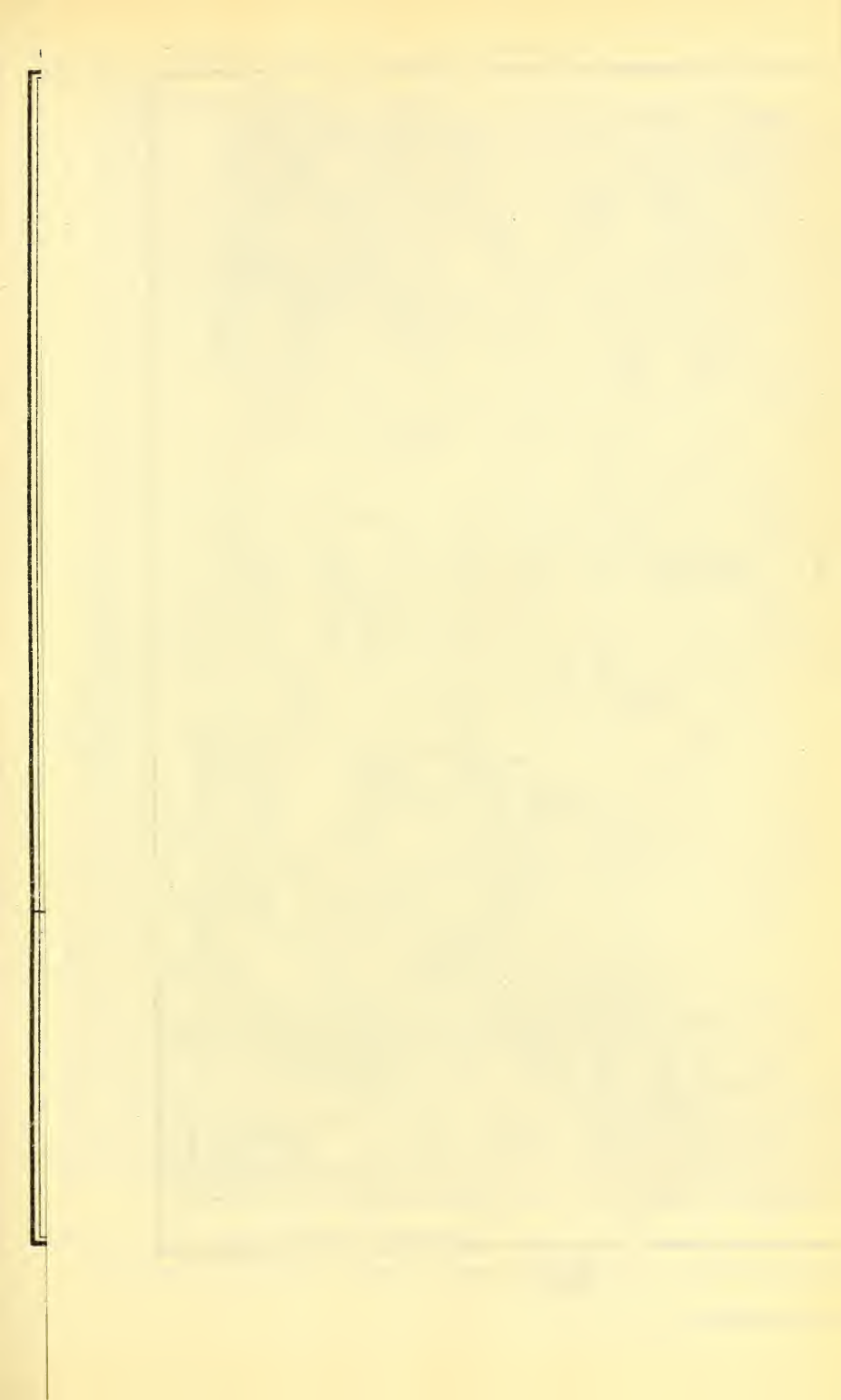
Owing to the wide range in the altitudes of different portions of the State the climate is varied to some extent. In the mountains the snows are sometimes heavy and the cold extreme, but in general this is not the case at lower elevations. While occasionally there are high winds or blizzards, their danger and severity are usually overestimated, and their duration is confined to a short interval of time. The mean temperature for the past ten years has been 40.8°, with a mean of 18.3° for January, 1907, the coldest month of that year, while for the warmest month of the same year, July, the average

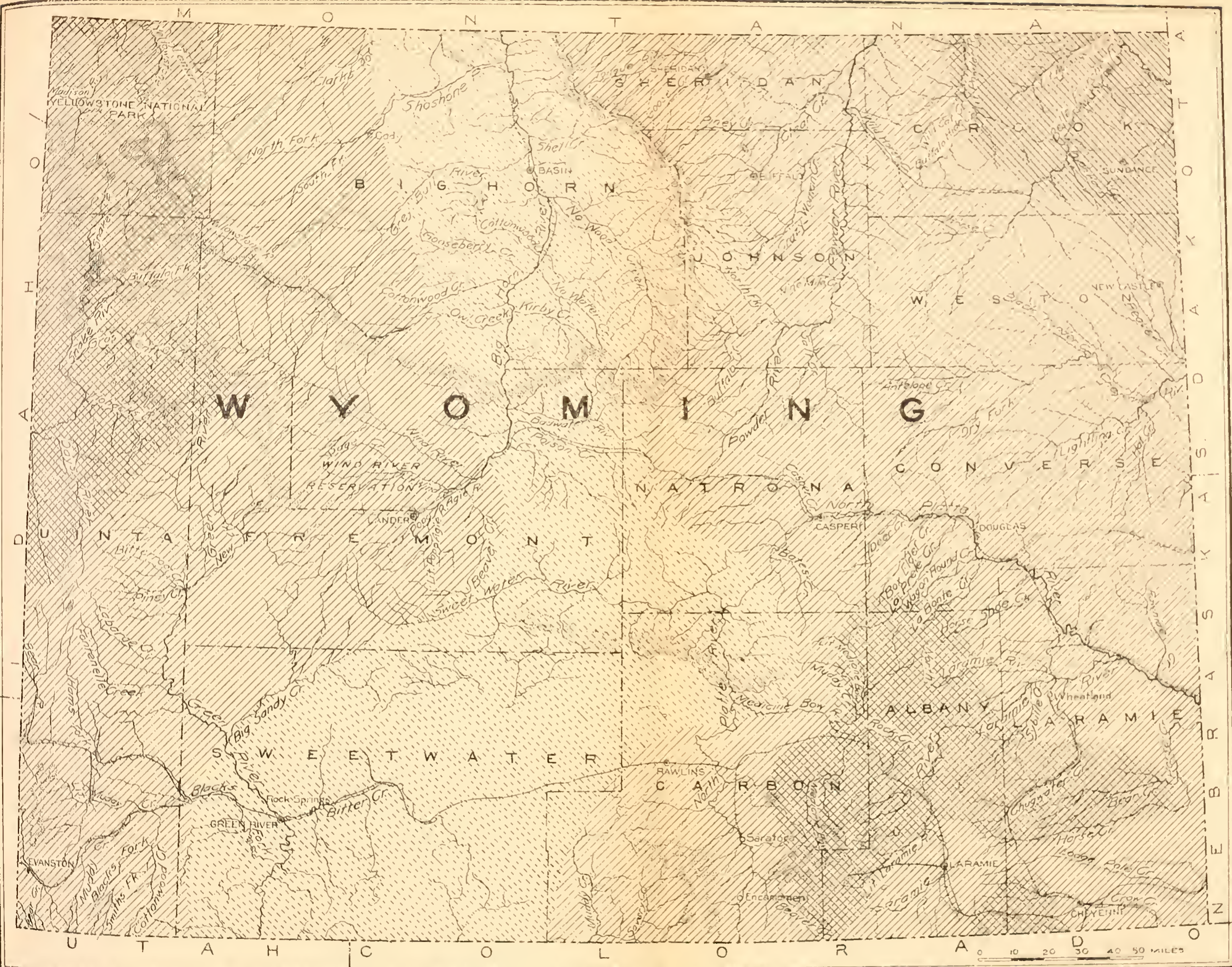




LEGEND { MISSOURI RIVER DRAINAGE. COLORADO RIVER DRAINAGE. COLUMBIA RIVER DRAINAGE. GREAT SALT LAKE DRAINAGE. FOREST RESERVES.

MAP OF WYOMING SHOWING DRAINAGE BASINS AND NATIONAL FORESTS,





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MAP OF WYOMING SHOWING ANNUAL PRECIPITATION.

temperature was 62.6°. In 1907 extreme low temperature of 38° and 40° below zero were recorded at two or three points in the mountains of the western part of the State, while a temperature greater than 100° during the summer of that year was recorded at only five of the observation stations of the Weather Bureau. The mean annual precipitation for the State, as obtained from the reports of the United States Weather Bureau for the past thirty-seven years, is 14.17 inches. (Pl. II.) This is also about the average for the eastern portion of the State, where from 70 to 75 per cent of the rain falls during the "growing season" from April 1 to September 30. This section is therefore adapted to either "irrigation" or "dry farming." In parts of the Big Horn Basin and the south central section of the State the annual precipitation averages less than 10 inches. The lands there are adapted to grazing, and farming by irrigation. West of the Continental Divide the mean annual rainfall is as high as 18 inches in some places, but less than 50 per cent occurs during the six months of the growing season. The average wind velocity is about 7 miles per hour. Higher winds sometimes prevail during the spring and fall, but hurricanes and tornadoes are unknown. In many parts of the State where the altitude is from 3,000 to 4,500 feet above sea level many varieties of both fruits and vegetables are grown successfully, as well as hay and grain. At higher elevations killing frosts sometimes occur in May and September, so that the raising of hay or alfalfa, grain, and hardy fruits only is attempted.

WATER RESOURCES.

Probably no locality in the world is situated to control as many drainage basins as Wyoming. From a single mountain, Mount Union, in the Wind River Range, run streams which furnish water to the Missouri, the Columbia, and the Colorado, thus flowing into the Gulf of Mexico, the Pacific Ocean at Astoria, and the Gulf of California. (Pl. I.)

The North Platte River drains most of the southeastern portion of the State. It rises in northern Colorado and crosses the Wyoming-Colorado line 120 miles west of the southeast corner of Wyoming. From that point it runs northerly for 125 miles to the town of Casper, thence east 50 miles to the town of Douglas, from which point its course is southeasterly to the Wyoming-Nebraska line, which it crosses 66 miles north of the southeast corner of Wyoming. Its principal tributaries are the Laramie, Sweetwater, and Medicine Bow rivers. Many small but important tributaries furnish water to the North Platte within the State, the larger number of which come from the Laramie, Seminole, Sierra Madre, and Medicine Bow mountains. The Sweetwater River drains a part of the eastern extremity of the Wind River Range.

That part of the State lying north of the drainage basin of the North Platte River and east of the Big Horn Mountains is drained by numerous tributaries of the Missouri. The streams of Sheridan County, together with Powder River and its western tributaries, drain the eastern slope of the Big Horn Mountains. As these mountains decrease rapidly in altitude south of Cloud Peak the water supply of the southern extremity of the range is less than that which is provided for Sheridan and northern Johnson counties. Cheyenne, Belle Fourche, Little Missouri, and Little Powder rivers and the eastern tributaries of main Powder River drain low lands, so that these streams, while furnishing a large volume of water during flood season, can not be depended upon during late July and August for irrigation unless storage works are provided.

Big Horn County and that part of Fremont County lying north of the Wind River Mountains are drained by the Big Horn River and its tributaries, and Clarks Fork and its tributaries. The Big Horn is a tributary of the Yellowstone, which, in turn, is a tributary of the Missouri. Big Horn River has its source in the Shoshone and Wind River mountains. Its principal tributaries flowing from these mountains are the Shoshone, Grey Bull, and Big and Little Wind rivers. The tributaries of the Big Horn from the Big Horn Mountains on the east vary in importance as do the streams on the eastern slopes of that range. Going south and up the Big Horn the streams gradually decrease in size, although this is not so noticeable unless a study is made of the No Wood River and its tributaries. The Big Horn River flows almost due north. It is formed by the junction of the Big and Little Wind rivers at a point 35 miles west of the center of the State. This junction is at the center of the State on a north and south line. The Grey Bull and Shoshone furnish more water than does the main stream above the junction of the Grey Bull and the Big Horn.

The fourth great natural water division is located in the western and southwestern part of the State. The principal rivers have their sources in the Wind River, Wasatch, Teton, Uinta, and Sierra Madre ranges. Snake River rises in the Yellowstone National Park and flows south into Jackson Lake, from which it flows southerly and crosses the Wyoming-Idaho line 125 miles south of the northwest corner of Wyoming. It has many important tributaries in Wyoming. Among them are Buffalo Fork, Gros Ventre, Hoback, John Days, and Salt rivers, the last emptying into the Snake in eastern Idaho.

Bear River rises in the Uinta Mountains in northeastern Utah and flows into Wyoming 8 miles east of the southwest corner of the State. It runs northerly and returns to Utah 36 miles north of the same corner of Wyoming, only to return to this State 20 miles farther north. Twenty-four miles north of this point it finally leaves the State, flow-

ing into Idaho, where it runs northwesterly, then southwesterly, entering Utah again and flowing into Great Salt Lake.

Green River rises in the Wind River Mountains 160 miles north of the southern boundary and 60 miles east of the western boundary of the State. A large part of the water of this river comes from the mountainous area lying in the vicinity of Fremont Peak. New Fork and its tributaries, therefore, gather a large volume of water in addition to what is supplied by the main stream. It flows southerly, crossing the Wyoming-Utah line 70 miles east of the southwest corner of Wyoming. An important tributary of Green River rises on the western slope of the Sierra Madre Range in Carbon County and in the mountains of northern Colorado and flows westerly. This stream also is called Snake River.

The sections of Wyoming which supply water to the Missouri, the Columbia, and the Colorado rivers and Great Salt Lake are shown on the accompanying map (Pl. I, p. 10).

THE NORTH PLATTE DRAINAGE BASIN.

The drainage area of the North Platte River in Wyoming is 13,866,032 acres, or one-fifth of the total area of the State. The mean annual discharge of the river at the Wyoming-Nebraska line is 1,500,000 acre-feet of water. Some of this volume comes from Colorado from the headwaters of both the Laramie and North Platte rivers. Probably 220,000 acre-feet of water is derived from this source. The following table shows the drainage area of the important tributaries of the North Platte in Wyoming, together with the mean annual discharge of each stream as accurately as can be estimated at the present time from the records of the United States Geological Survey and of the office of the State engineer of Wyoming:

Drainage areas and discharges of tributaries of North Platte River in Wyoming.

Stream.	Drainage area.	Discharge.	Stream.	Drainage area.	Discharge.
	<i>Acres.</i>	<i>Acre-feet.</i>		<i>Acres.</i>	<i>Acre-feet.</i>
Rawhide Creek.....	303,648	26,400	Medicine Bow River.....	1,539,979	135,000
Laramie River.....	2,394,996	300,000	Pass Creek.....	167,640	31,000
Cottonwood Creek.....	89,818	16,320	Jack Creek.....	95,260	17,100
Horse Shoe Creek.....	161,214	31,200	Spring Creek.....	114,620	21,300
La Bonte Creek.....	185,152	36,000	Cow Creek.....	65,670	12,200
La Prele Creek.....	156,453	30,000	Encampment River.....	119,570	47,300
Box Elder Creek.....	105,536	18,700	Brush Creek.....	57,420	10,700
Deer Creek.....	135,850	23,100	French Creek.....	41,580	9,200
Muddy Creek.....	97,790	13,600	Big Creek.....	74,140	13,900
Casper Creek.....	424,600	18,000	Douglas Creek.....	103,730	14,100
Bates Creek.....	249,480	43,400	Other tributaries in Wyoming.....	4,960,807	300,000
Poison Spider Creek.....	124,300	8,130	Water from Colorado.....		220,000
Canyon Creek.....	60,060	11,300			
Sweetwater River.....	1,839,519	60,000			
Sage Creek.....	178,200	34,200	Total.....		1,502,150

These figures represent the discharge that reaches the Platte from these tributaries rather than the total available supply that is furnished by them for local use. The average annual rainfall of the

North Platte drainage area within Wyoming is at least $13\frac{1}{2}$ inches. This should produce an annual run-off of 15,599,286 acre-feet of water. The records show that over 13,000,000 acre-feet of water are lost before the Platte River is reached. The run-off appearing in the streams accounts for a precipitation of about $1\frac{1}{2}$ inches only. The loss is due to evaporation from the surface of the ground and from plant life. The latter source of loss is much more important than it is generally considered to be. Trees, sagebrush, and all natural vegetation, together with cultivated crops, require large volumes of water. Some water doubtless escapes into the ground and appears beyond the borders of the State in the form of springs.

NORTHEASTERN DRAINAGE AREA.

The streams which have their source north of the drainage basin of the North Platte and east of the Big Horn Mountains are all tributary to the Missouri. Tongue River in Sheridan County carries a large volume of water, although, compared with the Cheyenne River, its drainage area is small. The main stream and all of its important tributaries have their sources in the Big Horn Mountains, while the Cheyenne River rises in a country of low elevation. Clear Creek and its tributaries are in the same class with Tongue River. Piney Creek, the principal tributary of Clear Creek, runs from its source on the eastern slope of Cloud Peak in a northerly direction, then turns east and southeast, flowing into the main stream near the boundary line of Johnson and Sheridan counties. It alone of all the branches of the main stream drains high mountainous country. Clear Creek is the main tributary of Powder River. The streams tributary to Powder River on the west and south of Clear Creek gradually decrease in discharge in proportion to drainage area as the mountain range is followed in a southerly direction. The tributaries of Powder River from the east are comparatively unimportant. They carry considerable water during flood season and only by providing storage works can they be made of great value to the irrigator. The remaining streams of this great drainage basin of 14,645,700 acres belong to the same class. The available information regarding discharges and areas of particular basins is set forth in the following table:

Drainage areas and discharges of streams in northeastern Wyoming.

Stream.	Drainage area.	Discharge.	Stream.	Drainage area.	Discharge.
	<i>Acres.</i>	<i>Acre-feet.</i>		<i>Acres.</i>	<i>Acre-feet.</i>
Cheyenne River.....	4,268,679	200,000	Western tributaries Powder River.....	2,582,490	310,000
Belle Fourche River.....	2,100,549	94,000	Tongue River.....	925,760	260,000
Little Missouri River.....	388,819	18,200			
Little Powder River.....	857,722	40,000			
Eastern tributaries Powder River.....	2,499,111	87,000			

NORTHWESTERN DRAINAGE AREA.

The best watered portion of the State lies in what is known as the Big Horn Basin and northern Fremont County. This territory is drained by the Big Horn River, with the exception of a small area east of the Yellowstone Park, which is tributary to Clarks Fork. Both the Big Horn River, and Clarks Fork flow into the Yellowstone River, a tributary of the Missouri. The mean discharge of the Big Horn River inclusive of all tributaries in Wyoming is not far from 3,500,000 acre-feet of water per annum. Some of the gauging records that have been kept of the Big Horn and some of its tributaries are incomplete, owing to the small number of actual discharge measurements and the limited season each year covered by gauge-rod readings. However, enough material is at hand to enable the State to make estimates which are not far from the truth. The Shoshone River is the principal tributary of the Big Horn, although the Grey Bull and Wind rivers are almost as important. All of these streams drain the eastern slopes of the Wind River and Shoshone Mountains.

The tributaries of the Big Horn from the east are unimportant with the exception of No Wood River and Shell Creek. These two streams drain the western slopes of the highest portion of the Big Horn Mountains and their various tributaries extend over such a wide area that other streams have no opportunity of reaching the region of heavy precipitation.

Some detailed information as to the water resources of this part of the State, embracing an area of 11,800,000 acres, is contained in the following table:

Drainage areas and discharges of streams in northwestern Wyoming.

Stream.	Drainage area.	Discharge.	Stream.	Drainage area.	Discharge.
	<i>Acres.</i>	<i>Acre-feet.</i>		<i>Acres.</i>	<i>Acre-feet.</i>
Clarks Fork.....	745,574	700,000	No Wood River.....	1,163,980	300,000
Shoshone River.....	1,702,195	1,200,000	Big Wind River.....	1,339,085	1,000,000
Grey Bull River.....	1,047,859	900,000	Little Wind River.....	465,408	300,000
Shell Creek.....	375,091	200,000	Big Popo Agie River.....	514,450	330,000

SOUTHWESTERN DRAINAGE AREA.

This area includes drainage basins which furnish water to the Columbia, reaching the Pacific Ocean at Astoria, Oregon; Great Salt Lake, through Bear River; and to the Gulf of California by way of Green River and the Colorado River. All the streams of this portion of the State have their sources in mountains where the precipitation is great, with the exception of the eastern tributaries of Green River. Green River proper is a large stream. New Fork and tribu-

taries drain the mountainous country lying on and to the southwest of Fremont Peak. This is a lake district and the summer flow of the various streams is consequently more uniform than would otherwise be the case. Green River rises northwest of Fremont Peak, draining one slope of that mountain. Large lakes lie near its headwaters.

The principal tributary of Bear River is Smiths Fork, which joins the main stream near Cokeville, close to the Idaho line. This tributary furnishes more water than does Bear River late in August.

Snake River when fully utilized in Wyoming will still discharge from 1,500,000 to 2,000,000 acre-feet of water per annum at the Wyoming-Idaho line. By using Jackson Lake and other lakes for storage Snake River will supply water for all lands that can be reclaimed along its valley, both in Wyoming and Idaho. The natural flow of the river might be said to be exhausted during the summer months; however, its discharge is complicated by so many conditions in Idaho that it remains to be seen how much storage will finally be necessary.

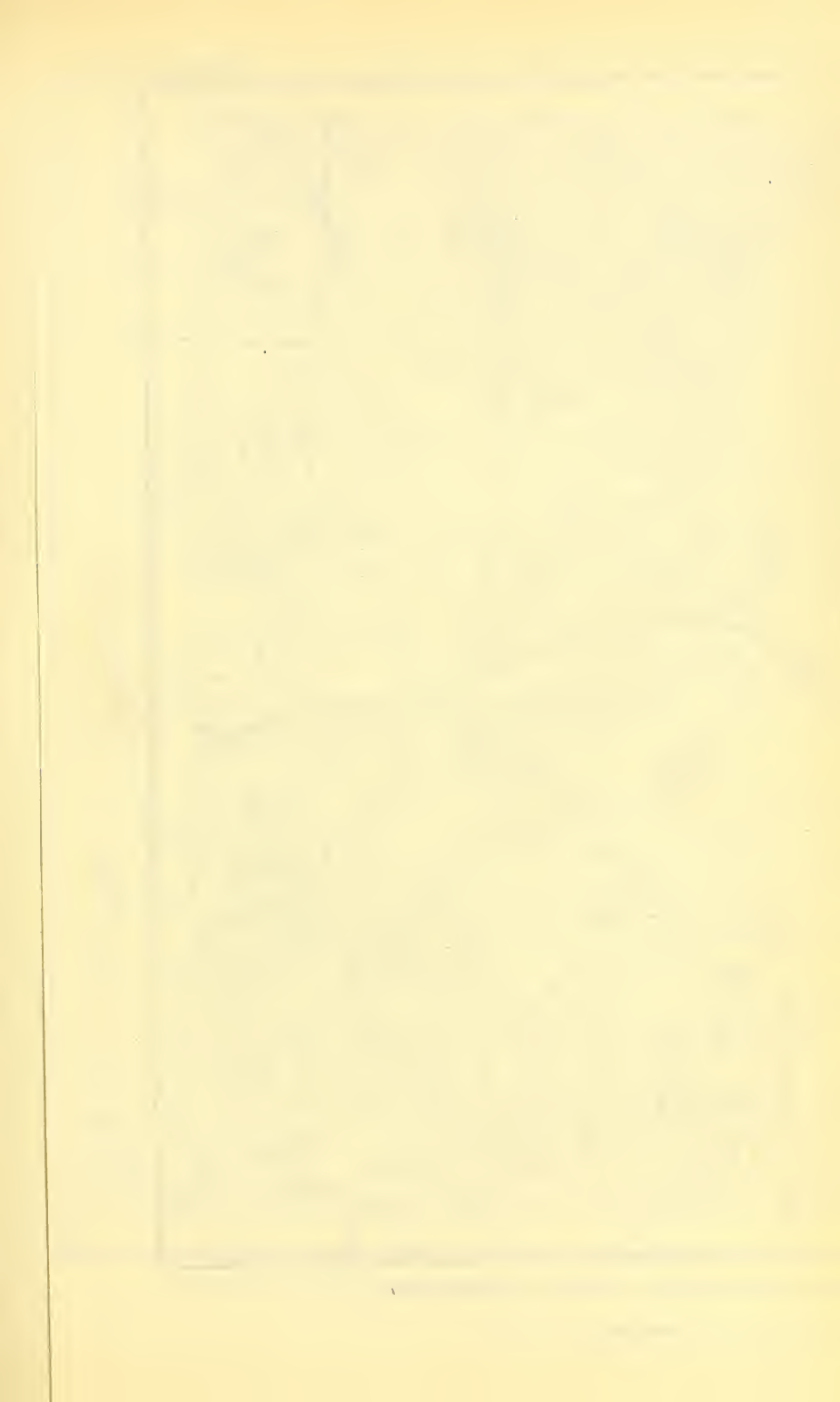
The following table gives some details regarding the streams of this part of Wyoming:

Drainage areas and discharges of streams in southwestern Wyoming.

Stream.	Drainage area.	Discharge.	Stream.	Drainage area.	Discharge.
	<i>Acres.</i>	<i>Acre-feet.</i>		<i>Acres.</i>	<i>Acre-feet.</i>
Green River.....	8,297,163	1,200,000	Bear River.....	962,150	500,000
Big Sandy River.....	1,178,726	150,000	Snake River.....	2,903,961	2,000,000
Blacks Fork River.....	2,152,847	400,000			

FUTURE WATER SUPPLY.

Development can take place along nearly every stream in the State where storage works are hereafter provided. The North Platte River from the mouth of the Sweetwater to the Nebraska line is probably taken care of in the way of storage by the construction of the great Pathfinder Reservoir by the Government. What development takes place in the future along the main stream below the reservoir must depend upon stored water. The same conditions prevail on the Shoshone River in Big Horn County, between the site of the Shoshone Reservoir being constructed by the Government and the mouth of that stream. It is probable that the works of the Wyoming Central Irrigation Company in Fremont County will store about one-half of the flood water of Big Wind River. This will leave from 300,000 to 500,000 acre-feet of water per annum which can be stored in the future. Much development can be brought about by storing water along Little Wind River and the Big Popo Agie River and tributaries. Fully six times the area now reclaimed in the vicinity of Lander can be irrigated by building reservoirs.







Much can still be accomplished by storing water on many of the smaller tributaries of the Big Horn. This work is being studied at the present time and the flood waters of Paint Rock and Shell creeks, Grey Bull River, Owl and Cottonwood creeks, and many other streams will be used more fully within the next few years.

The outstanding permits from Green River (see p. 45) will probably exhaust the summer flow of that stream, and those who plan larger development hereafter will be obliged to provide reservoirs. These can easily be secured, because the headwaters of the main stream and many of the tributaries are in a country of natural lakes which can easily be converted into large reservoirs.

Bear River is in the same condition, and large storage works are in contemplation for that stream.

Salt River, a tributary of Snake River, is still a large stream in Wyoming, although the waters of Snake River in Idaho will probably be fully used during the irrigation season within a few years. Snake River and its tributaries in Wyoming have scarcely been touched in this State.

Much development will take place within the next few years in the northeastern portion of the State. The lands are of first-class quality and lie so that they can easily be reclaimed. The construction of canals will be simple, and the only great problems to be solved will relate to the construction of reservoirs. Water can be secured in abundance, and there is no reason why the storage works should not be built, thus reclaiming a large area which can not be utilized to advantage by settlers depending altogether upon dry-farming methods.

CLASSIFICATION OF LANDS.

The area of Wyoming is 62,645,120 acres. Approximately 50,000,000 acres of this area, including the forest reserves, should be classified as grazing lands. This estimate excludes only about 800,000 acres of rough, mountainous country within forest reserves, where no vegetation grows, and lands which can be profitably cultivated either by dry farming or under irrigation. The area of the forest reserves in Wyoming is 8,998,723 acres.

The development of the State has reached that stage in which practically the entire summer flow of the streams is utilized. Approximately 1,000,000 acres of land is now irrigated. The total discharge of the streams is approximately 11,000,000 acre-feet per annum. When this is all stored and economical use enforced, it will be possible to irrigate five or six million acres of land. The location of this irrigable land is shown on the accompanying map, the irrigable areas being dotted; its total area as there represented is 6,200,000 acres. (Pl. III.) From four to ten million acres can be profitably farmed without irrigation where proper systems of cultivation, summer

fallowing, and rotation of crops are followed. On Plate I, p. 10, the boundaries of the forest reserves are shown. This land, with the exception of the high mountain regions above timber line and the extremely rough country below that elevation, together with all other lands of the State, excepting the areas marked as irrigable, will be utilized either for grazing purposes or for dry farming. From the records of the United States Weather Bureau for Wyoming lines have been established which fix approximately the boundaries of the districts where dry farming may be practicable. (See Pl. II, p. 10.) Wherever the rainfall is in excess of 10 inches per annum, this kind of agriculture will probably be more or less successful. All lands lying east of a line beginning on the boundary between Sweetwater and Carbon counties on the southern margin of the State and running northerly to the Montana line receive 10 inches of rainfall or more each year. The same is true of lands lying west of a similar line running northerly through the western part of Sweetwater, Fremont, and Big Horn counties. The lands lying between these two lines will probably continue to be used for grazing, except where water is provided for irrigation. It will be noticed that the large irrigable area in Big Horn County lies between these lines.

The land which will be devoted to agricultural purposes varies in quality. A sandy loam is best suited to diversified farming, because it does not bake when watered and because it is warm and easily cultivated. Much of the land of the State is of this character. The best indication of good land and the surest guide to those unacquainted with the conditions is the presence of sagebrush and the luxuriance of its growth. Land that will produce sagebrush can always be depended upon. Certain lands in their natural state bear salt sage, and these are generally of good quality. The prickly pear grows in sandy soils which are adapted to raising small fruits, melons, etc. Greasewood appears where the soil is not first class, and it thrives even on ground that is strongly alkaline. A considerable area, embracing southern Laramie and Albany counties, produces native grass to the exclusion of nearly all other vegetation. This land grows excellent crops of grain, field peas, and sugar beets, together with all kinds of garden produce, where water can be applied. Natrona, Converse, Fremont, Crook, Weston, Johnson, and Sheridan counties are great grass-producing sections, but in each there are considerable areas where sagebrush and even greasewood predominate.

Big Horn County contains much sagebrush land and large areas grow salt sage in their natural state. A large part of the territory covered by the Government irrigation project from the Shoshone River is salt-sage land. The same is true of the land under the system of the Big Horn Basin Development Company south of that river. The lands along the Shoshone and Grey Bull rivers are broken here

and there by bad-land hills from which soil has washed for many years. This soil, when properly drained and cultivated, is surprisingly productive.

Carbon County is a sagebrush country. Wherever smooth land can be irrigated it produces well. The great Continental Divide runs through western Carbon and eastern Sweetwater counties. This territory is celebrated as a winter sheep range particularly. Sagebrush, greasewood, and native grass furnish feed for many thousands of sheep, but owing to the scarcity of water it is often impossible to drive the flocks there until snow has fallen in the late autumn or early winter to provide a water supply.

Southwestern Sweetwater County is a greasewood country, although it is one of the important grazing districts of the State. The northwestern part of the county is covered with sagebrush, with greasewood appearing where the alkali has accumulated on low or flat ground. One of the large irrigation projects of the State is now under construction in the northern part of the county. The Big Sandy River is to supply this tract with water. A portion of the land under this project is rich in sand, which is a favorable quality in lands located at altitudes above 6,000 feet. A part of the construction work has been finished and settlers are now occupying the lands that are already covered by canals. This company estimates that more lands will be covered by ditches during the season of 1909.

Uinta County varies greatly as to the quality of its land. The southern part of the county is either a sagebrush country or rolling grassy prairie. The Upper Green River country is a continuous meadow. The Salt River Valley is a grass and sagebrush country in its natural state, as is the Jackson Hole territory immediately south of the Yellowstone Park.

IRRIGATED AREAS.

Uinta County will soon have a considerable area under ditch which will be ready for settlement. A project of considerable size is now under construction near Fort Bridger. This is the Utah-Wyoming Canal, with reservoir works located in Utah. Fully 6,000 acres will be opened for settlement within the next year or two. A very promising project has been investigated in Jackson Hole. This land is now in the forest reserve, but will doubtless be restored to entry when its real character becomes known to the officers of the Forest Service.

Along Green River two large projects have been laid out and an application for segregation of one tract of land has been filed with the officers of the local land office. As these have just been initiated, it is not probable that water will be ready for two years or more. From 60,000 to 150,000 acres of land can be reclaimed from Green River without resorting to a great deal of storage.

In southern Carbon County two large projects have been laid out and the lands segregated under the provisions of the Carey Act. Active construction work has not commenced on either project.

In Albany County, where for years native-grass meadows have been watered for the purpose of producing hay for winter feed, the people have suddenly come to the realization that these lands can be put to a higher and better use. The Millbrook ranch was the first to really accomplish anything extensive in the line of scientific and successful farming. It was shown there that all kinds of cereals, field peas, sugar beets, and vegetables could be raised profitably. The exhibit made at this ranch two years ago surprised the residents of the valley who had been acquainted with the lands for thirty years. It brought visitors from the East and since then large holdings have been gradually dissolving into farms. Opportunities can be secured in the neighborhood of Laramie for homes on the land at reasonable prices and probably 60,000 acres will be thus taken within the next few years.

At Wheatland in Northern Laramie County from 25,000 to 30,000 acres of land with the water rights are open to settlement. This is one of the oldest large projects in the State and some 25,000 acres are now farmed.

The Government Pathfinder project is located on the North Platte River. The Pathfinder Reservoir is located at the mouth of the Sweetwater River. The work on the dam is well along. The only canal in Wyoming connected with this project thus far begun is an enlargement and extension of the Whalen Falls Canal (see p. 28), which was started under the provisions of the Carey Act. There are 20,000 acres of land to be reclaimed under that act and about the same area under the extension made by the Government. The canal runs into western Nebraska, where a larger area is to be reclaimed. The Government has also projected the Goshen Hole Canal (see p. 28), which will reclaim approximately 200,000 acres of land on the south side of the North Platte River opposite the Interstate Canal, the enlargement and extension of the Whalen Falls Canal. Another canal has been investigated near Douglas, while a fourth has been laid out on the south side of the river in the vicinity of Casper. A fifth canal which would water a part of the lands under the Goshen Hole Canal has also been surveyed.

The La Prele Ditch and Reservoir Company of Douglas will open a tract of from 20,000 to 30,000 acres of land next season. Their canal is built and work is now in progress on a reservoir requiring a dam 135 feet in height.

Fremont County enjoys the distinction of having the largest irrigation project in the State, and it is neither under the Carey Act nor under the United States reclamation act. Ultimately 300,000 acres

in one body will be reclaimed under this project, which is situated on the ceded portion of the Shoshone Indian Reservation. These lands are subject to homestead entry. One canal has been finished and work on two larger ones will be begun within a short time. Reservoirs will also be built to store water that will be needed by so large an area late in the summer. The soil, climate, and all conditions are favorable to great agricultural development in this district.

Opportunities can be found for obtaining irrigated farms or irrigable land in Johnson and Sheridan counties. One project of 20,000 acres has been completed in southern Johnson County. This tract is now open to settlement. Sheridan County is developing rapidly and much has already been accomplished. A larger area has been brought under cultivation in Sheridan County, in proportion to its size, than in any other county of the State. Water can be diverted easily and the problem now is to store flood waters. Under a great storage system, Sheridan County will ultimately reclaim all irrigable lands within her borders. The great Lake De Smet Reservoir will lead to the reclamation of a large area in the near future.

Crook and Weston counties have many streams which supply large volumes of water during the flood season, but as few of these streams rise in high mountains the late summer flow is not great. For this reason and because of the heavy rainfall common to this part of the State dry farming is being extensively practiced. This is supplemented by irrigation in many places and there are good opportunities for extending the irrigated area by storing water. Marked development along agricultural lines is now taking place in both counties.

Big Horn County is to be the home of large irrigation works. It is to contain the highest dam in the world, now being constructed by the United States Reclamation Service. Probably this county will contain a larger area of irrigated land than any other county in the West. The first large canal built in this part of the State was turned over to the settlers two years ago. They now have charge of the maintenance of the system. It is located on the south side of the Shoshone River, near Cody, and will reclaim 13,000 acres of land. There are opportunities for settlers under this canal, probably 5,000 acres being unoccupied. The Bench Canal, diverting water from the Grey Bull River, offers some inducements to settlement, but the remaining unoccupied lands are to be watered from the project of the Big Horn Basin Development Company taking water from the South Fork of the Shoshone River and storing it in the Oregon Basin Reservoir. This larger project is now under construction and in a few years many thousands of acres of good land will be under ditch. It is a great undertaking and stands among the large irrigation enterprises of the West.

The Hanover Canal, taking water from the Big Horn River, together with the second canal built by the same company and taking water from the same source, provides opportunities for settlement on from 10,000 to 15,000 acres of land at the present time. Conditions are favorable for immediate settlement under this system, as is the case under the Big Horn County Canal, which diverts water from the same river and reclaims an area of 20,000 acres on the west side of the river. Fully 12,000 acres of good land are now open to settlement.

The lands under the Lovell and Sidon canals, taking water from the Shoshone River, are about all taken, and prosperous farming communities and several good towns have sprung up.

The work of the Government is very important to this county. The great reservoir dam, before referred to, will probably be completed within the next year. One canal has been so far completed as to provide water for 15,000 acres between Corbett and Garland. The work done on these canals is first class in all details and it has been an object lesson to all who have had the opportunity to make inspection. Settlement of these lands is controlled by the United States Reclamation Service, and details can be obtained by writing to the officers of the service at Washington, D. C., or to local engineers at Cody, Wyo., or at Huntley, Mont.

The project of the Wyoming Land and Irrigation Company, which is to take water from Paint Rock and Shell creeks, has been taken up and construction commenced. This will reclaim from 10,000 to 15,000 acres for the season of 1909, and the area will be gradually increased until from 50,000 to 60,000 acres have been reclaimed. This project depends largely upon stored water. The lands are among those having the lowest altitude in the State and this will probably become a great fruit district.

Several other projects are now under consideration. The Wagon Wheel Canal, taking water from Porcupine Creek and watering lands on the east side of the Big Horn River, opposite the mouth of the Shoshone River, has been surveyed and the lands have been included in an application for segregation under the provisions of the Carey Act. The Ten Sleep and Bonanza Canal, taking water from Ten Sleep Creek, a tributary of the No Wood River, is in the same condition. The Hubbard Canal, proposing to divert water from Clarks Fork, 30 miles north of Cody, has been worked out from an engineering standpoint, but owing to some complications regarding the lands, construction work has not yet commenced.

The Buffalo Basin project, south of the Grey Bull River, will probably become one of the most important in the State. Large areas of fine sagebrush land can be reclaimed under this project, but water must be stored for the entire tract. Surveys have been completed and it is believed that work will begin on this project within the next year.

PRODUCTS OF IRRIGATED LANDS.

Wyoming is rapidly increasing its agricultural production. In this evolution the ratio between the area of land devoted to the raising of forage crops to the total area cultivated is decreasing. Although the State must always be noted for its live stock, yet in the large agricultural districts cereals, sugar beets, garden vegetables, and fruits will be generally grown.

Native grasses are still the principal irrigated crop. Fully 400,000 acres is devoted to this kind of agriculture, which produces about a ton of native hay per acre. Besides this the meadows have great value for winter forage. The hay has an average value of \$10 per ton. Alfalfa is second in importance. There are over 100,000 acres of alfalfa in the State, which produces from 2 to 3 tons of hay per acre per annum, having an average value of from \$6 to \$8 per ton. In addition to these two important crops raised for hay, there is at least 100,000 acres of land devoted to the growing of clover, timothy, redtop, millet, and Hungarian grasses, and considerable areas are planted to various grains, such as wheat, rye, barley, and oats, which are cut green and fed as hay. The value of the hay crop of the State, not including the pasturage value of the meadows, is approximately \$8,000,000 per annum. Of this sum \$4,000,000 or more is profit. Nearly all of the hay produced is consumed by live stock in the immediate locality where it is raised.

The most important cereal at this time is oats. Fully 50,000 acres of land is devoted to the growing of this crop. Oats produce well and the grain is unusually heavy. The average yield is above 35 bushels per acre. In the sections best adapted to the crop yields of from 60 to 75 bushels per acre are common. The average weight is not far from 45 pounds per bushel. The mean profit for oats is approximately \$10 per acre.

Wheat is second in importance among the cereals. It is grown to a greater extent each year as local flour mills are established. From 400,000 to 500,000 bushels of wheat is grown per annum, having a value of from \$300,000 to \$350,000 per annum. The wheat grown in Wyoming finds a ready local market wherever considerable settlement has taken place and milling facilities have been provided.

Barley, rye, and corn are grown in some sections. Hard corn grows well at altitudes not greater than 4,600 feet, and this crop promises to be common in Big Horn County, where the summer is long and the nights are warm.

Approximately 10,000 acres of land is devoted to the growing of vegetables in Wyoming, not including the area on which sugar beets are raised. This latter crop is becoming a very important one in Sheridan and Big Horn counties. The beets are generally grown on land

that has first been cropped to alfalfa. The beets are at present shipped to Billings, Mont. It is believed that a sugar plant will be established in either Big Horn or Sheridan County within the next year.

The value of the garden vegetables grown in the State is very close to \$100,000 per annum. It is difficult to obtain any reliable statistics relative to the various vegetables grown or their values, owing to the comparatively small area devoted to gardens and the large number that should be reported. Regardless of the seemingly large vegetable production, the local demand is greater by far than the available supply from local sources. There are opportunities in every county for vegetable gardeners.

The following reports received from farmers under the Bench Canal, Big Horn County, indicate the profits derived from various crops grown:

Herman Werbelow, on 50 acres—

675 bushels oats, at 50 cents.....	\$337. 50
465 bushels wheat, at 50 cents.....	232. 50
80 bushels potatoes, at 60 cents.....	48. 00
100 bushels corn, at 50 cents.....	50. 00
Garden.....	100. 00
40 acres fall pasture.....	40. 00
230 bushels rye, at 50 cents.....	115. 00
Total.....	<u>923. 00</u>

Fritz Moeller, on 150 acres—

1,900 bushels oats, at 50 cents.....	950. 00
350 bushels wheat, at 50 cents.....	175. 00
70 pounds alfalfa seed, at 12 cents.....	8. 40
30 tons hay, at \$4.....	120. 00
Garden.....	50. 00
50 bushels potatoes, at 60 cents.....	30. 00
100 acres fall pasture.....	100. 00
Total.....	<u>1,433. 40</u>

G. K. Baker, on 160 acres—

150 tons hay, at \$4.....	600. 00
600 bushels oats, at 50 cents.....	300. 00
100 bushels wheat, at 50 cents.....	50. 00
150 bushels barley, at 60 cents.....	90. 00
2 tons sugar beets ^a	40. 00
150 bushels potatoes, at 60 cents.....	90. 00
2,000 pounds alfalfa seed, at 12 cents.....	240. 00
Garden.....	100. 00
160 acres fall pasture.....	160. 00
Total.....	<u>1,670. 00</u>

^a Used for feed.

Friedrich Mayland, on 160 acres—

2,200 bushels oats, at 50 cents.....	\$1,100. 00
200 bushels wheat, at 50 cents.....	100. 00
65 bushels barley, at 60 cents.....	39. 00
100 bushels potatoes, at 60 cents.....	600. 00
75 tons hay, at \$4.....	300. 00
Garden.....	50. 00
100 acres fall pasture.....	100. 00
Total.....	<u>2,289. 00</u>

W. H. Packard, on 240 acres—

75 tons of hay, at \$4.....	300. 00
1,000 bushels oats, at 50 cents.....	500. 00
250 bushels wheat, at 50 cents.....	125. 00
Garden.....	700. 00
240 acres fall pasture.....	240. 00
5,000 pounds honey, at 10 cents.....	500. 00
Total.....	<u>2,365. 00</u>

J. Adam Preis, on 160 acres—

3,324 bushels oats and wheat, at 50 cents.....	1,662. 00
110 bushels barley, at 60 cents.....	66. 00
100 tons hay, at \$4.....	400. 00
200 bushels potatoes, at 60 cents.....	120. 00
Garden.....	100. 00
160 acres fall pasture.....	160. 00
Total.....	<u>2,508. 00</u>

William Peper, on 80 acres—

1,160 bushels oats, at 50 cents.....	580. 00
70 bushels wheat, at 50 cents.....	35. 00
70 bushels barley, at 60 cents.....	42. 00
75 bushels corn, at 50 cents.....	37. 50
50 bushels potatoes, at 60 cents.....	30. 00
Garden.....	50. 00
80 acres pasture.....	80. 00
Total.....	<u>854. 50</u>

W. A. Shoemaker, on 160 acres—

150 tons hay, at \$4.....	600. 00
1,100 bushels oats, at 50 cents.....	550. 00
500 bushels wheat, at 50 cents.....	250. 00
100 bushels potatoes, at 60 cents.....	60. 00
2,000 pounds alfalfa seed, at 12 cents.....	240. 00
Garden.....	50. 00
160 acres pasture.....	160. 00
Total.....	<u>1,910. 00</u>

V. G. Lantry, on 160 acres—

800 bushels oats, at 50 cents.....	400. 00
200 tons hay, at \$4.....	800. 00
160 acres fall pasture.....	160. 00
Total.....	<u>1,360. 00</u>

Joseph Hany, on 50 acres—

250 bushels oats, at 50 cents.....	\$125.00
430 bushels wheat, at 50 cents.....	215.00
20 tons hay, at \$4.....	80.00
150 bushels potatoes, at 60 cents.....	90.00
Garden.....	25.00
50 acres fall pasture.....	50.00
2 tons beets ^a	40.00
Total.....	625.00

J. S. Nicholson, on 80 acres—

1,350 bushels oats, at 50 cents.....	675.00
100 bushels wheat, at 50 cents.....	50.00
40 bushels barley, at 60 cents.....	24.00
18 tons hay, at \$4.....	72.00
40 acres fall pasture.....	40.00
Total.....	861.00

Orin Perry, on 20 acres—

150 bushels oats, at 50 cents.....	75.00
150 bushels potatoes, at 60 cents.....	90.00
Garden.....	200.00
20 acres pasture.....	20.00
8,000 pounds honey, at 10 cents.....	800.00
Total.....	1,185.00

J. W. Bell, on 160 acres—

3,204 bushels oats, at 50 cents.....	1,602.00
365 bushels wheat, at 50 cents.....	182.50
100 bushels barley, at 60 cents.....	60.00
300 bushels potatoes, at 60 cents.....	180.00
Garden.....	50.00
30 acres fall pasture.....	30.00
Total.....	2,104.50

Dry farming is an industry by itself. No man can prophesy accurately what its future will be. Under irrigation larger crops can be counted on annually from the same tract of land; the straw and grain will be heavier. Dry-farm grain is hard and of good quality where proper seed has been sown and care in cultivation is exercised by the farmer. Dry-land alfalfa seed is a valuable commodity throughout the West and there is a great demand for it in the Middle States at the present time. It has been found that this kind of seed produces an alfalfa which will grow where the climatic conditions are altogether unfavorable to seed grown either under irrigation or in places where rainfall is ample for agriculture without intensive cultivation. It will probably be found that as the knowledge of dry farming grows and as the farmer learns to cultivate, summer fallow, and rotate crops,

^a Used for feed.

new and hardy varieties will be produced which will thrive in places where the annual rainfall is much less than 10 inches. Potatoes raised under the dry-farming system are dry and much superior to those which are raised by irrigation. They are not so large, perhaps, nor do they weigh so much per bushel. What they lack in these particulars they more than compensate for in quality and they bring a better price on the market. With conditions favoring dry farming there is no reason why it should not gradually extend until all of the tillable land not irrigated, wherever the rainfall is sufficient, is occupied. To make this kind of agriculture a great success the farmer must have a larger area under his control than is the case where land can be irrigated. Summer fallowing means idle land—not idle in one sense, because it is at work gathering moisture—but it is productive only every other year.

Under former conditions settlement took place only along the streams. The outlying country was devoted to grazing. With the advent of the dry farmer these outlying lands are taken. The open-range business becomes impossible, and yet the dry farmer can not succeed unless he is favored. He should have a few cattle, horses, and sheep, and these can not graze on a homestead of 160 acres, only 80 acres of which are producing at any one time. He should have at least 640 acres that he can control. The land is worth but little as it stands, and the settler is certainly of sufficient value to the State and nation to justify each in doing its utmost for him.

IRRIGATION ENTERPRISES.

The principal purpose of this bulletin is to present the information needed by persons contemplating settlement upon irrigated lands in Wyoming. The information contained in the preceding pages is more or less general. In the following pages more definite information regarding irrigation enterprises affording opportunities for settlement is given.

Only a brief discussion of the principal features of each irrigation enterprise or project can be given. The object will be to set forth only a few of the leading points relative to each, and to indicate where they are situated and to whom interested parties may refer for complete details. It is impossible to undertake a review of the smaller ditch and canal systems. These published in tabular form without any discussion would require at least two hundred pages of text. Information of this kind relating to any particular district can usually be furnished by the State engineer of Wyoming. Every two years a pamphlet is published showing the adjudicated rights to use water in each water division. These pamphlets are sent to those who desire them without charge. The report of the State engineer,

prepared every two years, contains a list of all permits issued by his office during the period covered by the report.

To enable the reader to locate quickly any irrigation project described in the following pages, reference is made to the township and range lying nearest the center of the lands to be reclaimed. The projects are taken up in the numerical order of the water division in which they are located. The project nearest the southeast corner in any water division is described first, and others are taken up in turn as the division is covered to the northeast, the northwest, and the southwest.

INTERSTATE CANAL, WYNCOTE, WYOMING.

[T. 24 N., R. 62 W.]

The North Platte Canal and Colonization Company began the construction of the Whalen Falls Canal a year or so prior to the passage of the United States reclamation act. Under the Carey Act

14,424.44 acres were segregated. The company has under permit 20,000 acres, of which over 5,100 acres are deeded lands. The lands and water rights, with a proportionate interest in the irrigation works, can be obtained for \$30.50 per acre.

When the reclamation act went into effect it was found

advisable to build a large reservoir on the North Platte River near the mouth of the Sweetwater River, which would store a million acre-feet of water. In connection with this reservoir, several canals were planned. The largest of these are the Goshen Hole Canal, covering 200,000 acres on the south side of the North Platte River in northern Laramie County, and the Interstate Canal, which is an enlargement of the Whalen Falls Canal, on the north side of the same river.

The Interstate Canal has been completed to the Wyoming-Nebraska line, while work has not yet been commenced on the Goshen Hole Canal. (Figs. 1 and 2.) The company has a contract with the North Platte Canal and Colonization Company whereby water is

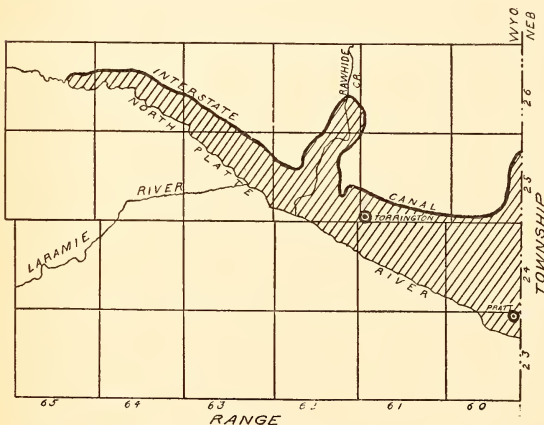


FIG. 1.—Interstate Canal.

delivered to the various users interested in the permit granted to that company. Several towns have sprung up along the line of the Burlington Railroad, which passes through this farming district. The lands embraced under this project are at an elevation of about 4,200 feet.

WYOMING DEVELOPMENT COMPANY CANALS, WHEATLAND, WYOMING.

[T. 24 N., R. 63 W.]

In 1883 work was begun on the first large irrigation project in Wyoming. The plans contemplated the diversion of water from the Big Laramie River at a point in the Laramie Mountains just west of the Laramie-Albany county line. This diversion includes water from Laramie River and Blue Grass Creek, a tributary of Sybille Creek, the latter in turn being a tributary of the Laramie.

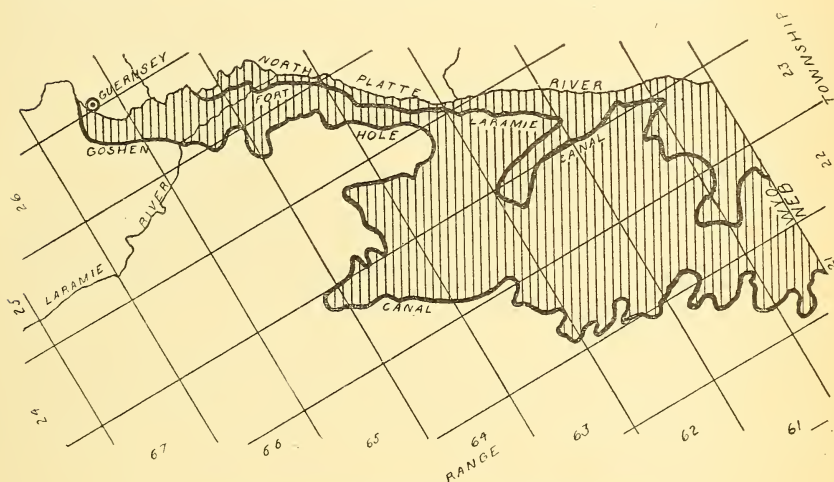


FIG. 2.—Proposed Goshen Hole and Fort Laramie canals.

Three canals have been completed diverting water from Sybille Creek, and 60,000 acres are included under this system. The land was taken up under the Desert-land Act, but patents were not secured by the company until 1894. The lands reclaimed lie between Sybille and Chugwater creeks and south of Laramie River.

Since 1894 rapid progress has been made in the settlement of these lands and a prosperous farming community has sprung up, with the result that Wheatland, located on this tract, has developed into an enterprising and substantial town.

About eight years ago the company completed a large reservoir system storing 132,000 acre-feet of water. The principal reservoir is located on the Laramie plains just before the river enters the Laramie Mountains. This reservoir stores 120,000 acre-feet of

water. A smaller reservoir is located in the midst of the farming land some 7 miles southwest of the town of Wheatland. The company now has sufficient stored water to reclaim all the land it controls. During the last two years the company has constructed a branch from its upper canal and has obtained 7,000 acres of land, under the Carey Act, lying south of the main tract and bordering on Chugwater Creek.

The Carey Act lands, with perpetual water rights and an interest in the irrigation works, can be obtained for \$37.50 per acre. The deeded lands under the original project can be obtained at prices ranging from \$22.50 to \$50 per acre. The altitude of these lands is about 4,000 feet and the soil is rich and sandy loam. (Fig. 3.)

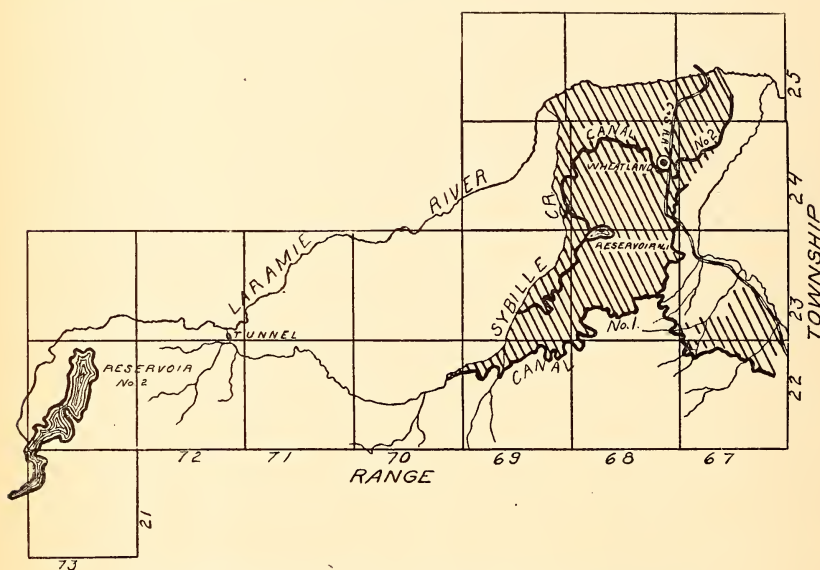


FIG. 3.—Reservoirs and canals of the Wyoming Development Company.

LA PRELE DITCH, DOUGLAS, WYOMING.

[T. 32 N., R. 72 W.]

The lands of this company lie just west and across the North Platte River from the town of Douglas, in Converse County, and enjoy first-class transportation facilities.

The company has about 20,000 acres of land segregated under the Carey Act, lying under a canal which has already been completed. The company is now at work on a reservoir which will store the flood water of La Prele Creek. This reservoir lies just above the headworks of the canal. These lands can be secured, together with perpetual water rights and an interest in irrigation works, at

\$30.50 per acre. The lands are of first-class quality, the presence of sagebrush guaranteeing productiveness. Their elevation is about 4,800 feet. (Fig. 4.)

DOUGLAS CANAL, DOUGLAS,
WYOMING.

[T. 33 N., R. 72 W.]

The old Fort Fetterman Reservation was located on some bottom land lying just west of the town of Douglas on the North Platte River. These lands were all taken up under the homestead act after the reservation had been abandoned, and a large canal has been constructed by local capitalists for the irrigation of the entire tract. The land is smooth and of good quality. The Chicago and Northwestern Railroad passes through the tract, which has an elevation of about 4,500 feet. (Fig. 5.)

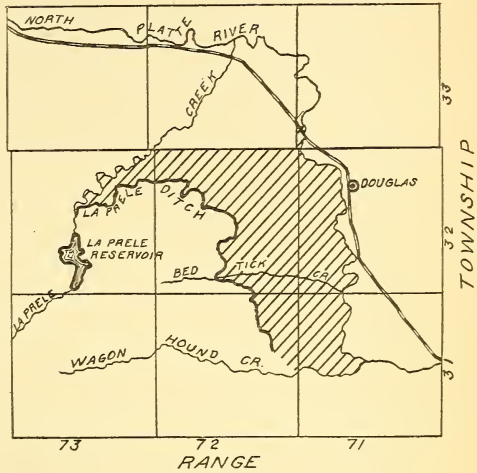


FIG. 4.—La Prele Ditch.

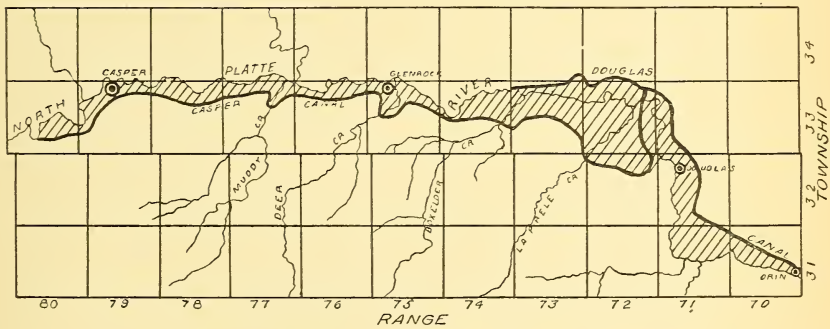


FIG. 5.—Douglas Canal and proposed Casper Canal.

SARATOGA CANAL, SARATOGA, WYOMING.

[T. 17 N., R. 83 W.]

Under this project 18,171.27 acres of land have been segregated under the Carey Act. The company has also secured a large area of patented lands. The tracts to be reclaimed lie on the east side of the North Platte River east of the town of Saratoga, in Carbon County. Surveys are now in progress having for their purpose the checking of the original work done some years ago. If this project

is found to be as feasible as was reported by the surveyors who performed the initial work, it is possible that construction will commence within the next few months. The elevation of these lands is 7,000 feet. (Fig. 6.)

NORTH PLATTE AND ENCAMPMENT
CANAL, ENCAMPMENT, WYOMING.

[T. 15 N., R. 83 W.]

The North Platte and Encampment Canal Company has two segregations of land under the Carey Act, aggregating in all nearly 50,000 acres. These lands lie to the east and north of the town of Encampment on the west side of the North Platte River, in Carbon County, Wyo. This project has been studied in detail on the ground, but actual construction work has not reached that point where settlement can be invited. Owing to the mining development in surrounding mountains a ready home market would be provided for all products that could be raised. The altitude of these lands is about 7,300 feet. (Fig. 7.)

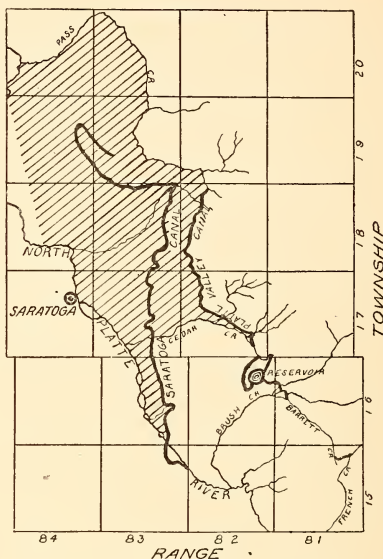


FIG. 6.—Saratoga and Platte Valley canals.

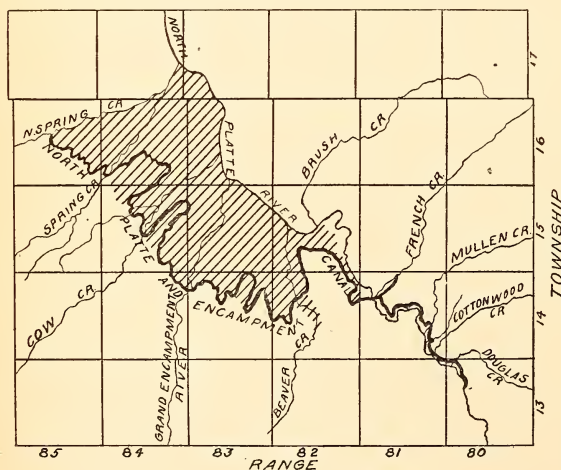


FIG. 7.—North Platte and Encampment Canal.

ROCK CREEK DITCH
AND RESERVOIR,
ROCK RIVER,
WYOMING.

[T. 20 N., R. 77 W.]

This project contemplates the storage of the waters of Rock Creek, on the Laramie Plains, and their utilization in the development of a tract of about 50,000 acres of fine irrigable lands,

which have been used for many years as the range of one of the largest of the old-time companies. Much of this land has

been irrigated for the purpose of increasing the growth of grass for pasturage. There is a considerable area of Government land which can be taken up by settlers, while the deeded lands of the company and the State lands can be purchased. The company is ready to furnish water to a part of the land at the present time. The elevation of this land is about 6,700 feet. (Fig. 8.)

LARAMIE VALLEY IRRIGATION DISTRICT.

[T. 18 N., R. 75 W.]

In southern Albany County there is a large district which has been devoted exclusively to the live-stock industry until the past few years. This district is tributary to the Laramie River and the soil is of excellent quality. The land lies in gentle slopes which can be irrigated easily.

Several canals and small ditches have been built during the past twenty-five or thirty years, but because of the greater importance of the live-stock interests agriculture

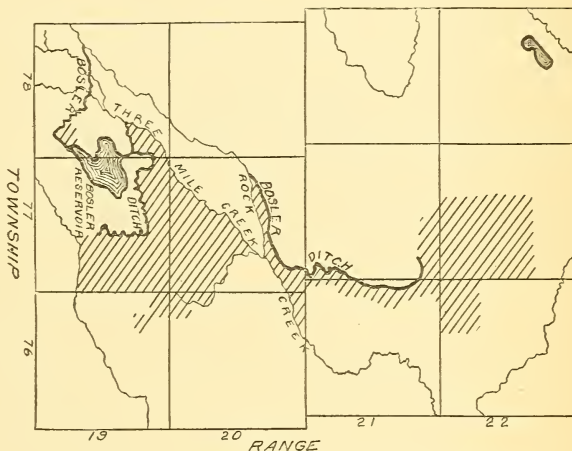


FIG. 8.—Rock Creek or Bosler ditches and reservoir.

has not thrived except in conjunction therewith. A few owners have grown all kinds of cereals, field peas, and forage crops in great abundance. This has awakened an interest in agriculture generally and has led to the organization of an irrigation district which will probably be the forerunner of a great agricultural community. This district embraces the deeded lands lying along the Laramie River north of the junction of that stream with the Little Laramie River. As there was a considerable area of public land in this tract, this has been taken up under the provisions of the Carey Act. As rapidly as patents issue to the settlers they will be taken into the irrigation district.

The irrigation works consist of the Oasis Canal, diverting water from the Big Laramie River and irrigating land on the east side of that stream, and a canal diverting water from the Little Laramie River and supplying James Lake, which is utilized as a reservoir.

The distributary system runs from this lake to the lands to be reclaimed. The Oasis Canal is already built and work will doubtless be commenced on the other canals and reservoirs as soon as the Carey Act lands have been segregated to the State.

It is probable that the Pioneer Canal and other irrigation works will be absorbed into this one large enterprise and a sufficient volume of water stored to reclaim all lands that are susceptible of irrigation. Other interests are busily engaged in surveys and in making plans for the reclamation of large tracts in this valley, so that within the

next three or four years the city of Laramie will be the center of a great agricultural community. This tract of land has an elevation of about 7,000 feet. (Fig. 9.)

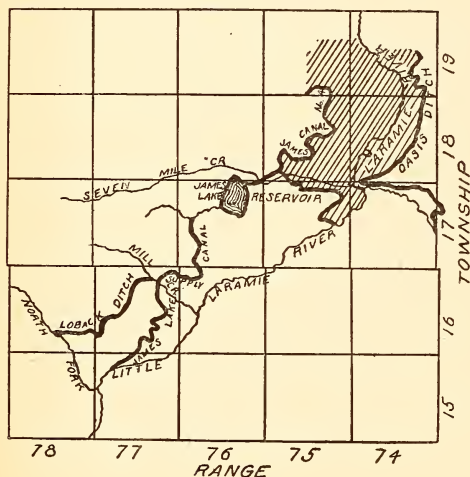


FIG. 9.—Ditches and reservoir of the Laramie Valley irrigation district.

LAKE DE SMET PROJECT,
SHERIDAN, WYOMING.

[T. 52 N., R. 81 W.]

Lake De Smet is located in northern Johnson County. Two or three small streams furnish water to this lake, but it is proposed to take the flood water from Piney

Creek and improve the land and use it as a storage reservoir. The water from the lake will be turned back into Piney Creek and diverted from the north side of that stream for the irrigation of a considerable area lying east of the town of Sheridan and along small tributaries of Tongue River, at an elevation of about 4,600 feet.

The land is largely owned by private parties at the present time. As it seems probable that a beet-sugar plant will be erected at Sheridan within the next year or two these lands will all have high value.

SAHARA DITCH, BUFFALO, WYOMING.

[T. 44 N., R. 78 W.]

The Sahara Ditch is the largest irrigation canal in Johnson County. The canal takes water from Powder River at a point near the junction of the North Fork and the Middle Fork and covers lands lying on the

north side of the main stream. About 20,000 acres of land lie under this canal, 7,920.3 of which has been segregated under the Carey Act. The lands are rich and lie at an altitude of from 4,000 to 4,600 feet. These lands, with perpetual water rights and an interest in irrigation works, can be secured for \$30.50 per acre.

The lands are adapted to the raising of sugar beets, all kinds of grains, and forage crops, and it is probable that this tract will be found adapted to the growing of fruit. (Fig. 10.)

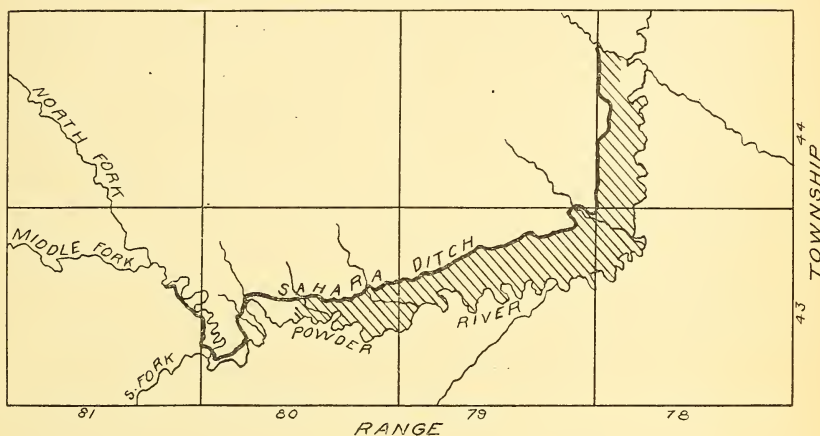


FIG. 10.—Sahara Ditch.

WYOMING AND FREMONT CANALS, RIVERTON, WYOMING.

[T. 3 N., R. 3 E., W. B. M.]

Prior to the opening of the Shoshone Indian Reservation the State secured the consent of the Secretary of the Interior to make surveys for canals and reservoirs for the reclamation of the ceded portions of that reservation. These surveys were made during the winter, spring, and summer of 1906 and all maps, plans, and estimates were on file for this work in the office of the State engineer on August 1 of that year. This project had been given wide publicity, and all parties interested in irrigation development were asked to submit propositions to the State setting forth their plans for carrying out this construction. These propositions were required to include the kind of construction proposed, the cost of water rights and permanent interest in irrigation works to the settlers, the kind of contract to be adopted, and all particulars which might affect the development of this region. The bids received were opened on August 1, 1906, and permits, which had already been prepared in the form of applications in blank, were issued to the Wyoming Central Irrigation Company, a corporation organized for the purpose of carrying out this work. These lands

were opened subject to the homestead act only, so that the project can not be carried out under the provisions of the Carey Act.

The most approved form of water-right contract has been adopted, with low rates for perpetual water rights and a proportionate interest in irrigation works. The company is required to install first-class structures throughout, thus insuring a cheap rate of maintenance when the works are completed. When 90 per cent of the interest in irrigation works is sold to the water users the management of the works is to be turned over to the water users. The company will also provide sufficient stored water to furnish an ample supply throughout the irrigation season.

One canal covering 15,000 acres has already been completed. Other canals covering from 250,000 to 300,000 acres will be begun

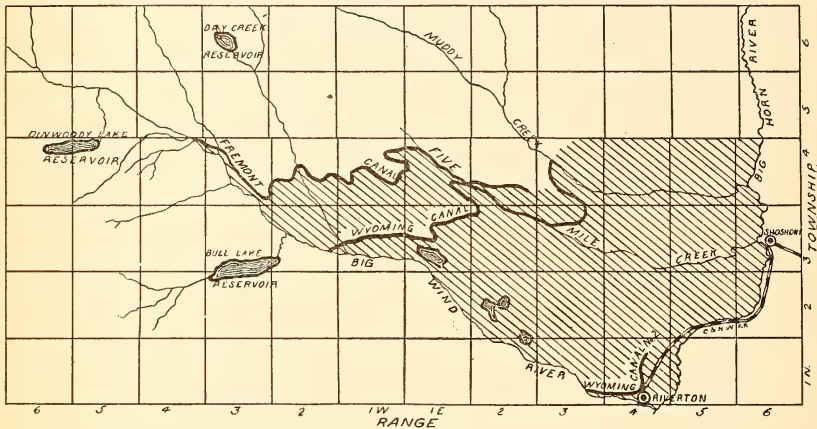


FIG. 11.—System of the Wyoming Central Irrigation Company.

within the next few months. This tract has an elevation of about 5,000 feet. (Fig. 11.)

BUFFALO BASIN PROJECT.

[T. 47 N., R. 94 W.]

This project is located south of the Grey Bull River on a number of small tributaries of Big Horn River. A large body of fine land has been located and surveys have been made by a number of parties to ascertain the feasibility of reclaiming them.

If the project is carried out reservoirs will be built which will be filled by canals diverting water from Wood River and Grey Bull River. Doubtless permits will be issued soon for the necessary irrigation works and an application will be made for the segregation of the entire tract under the Carey Act. About 100,000 acres of land will be reclaimed in this way, lying at an elevation of about 4,500 feet.

HANOVER CANAL, WORLAND, WYOMING.

[T. 47 N., R. 92 W.]

The Hanover Canal Company has built and now controls two canals, both diverting water from the Big Horn River. The upper canal takes water from the river near the mouth of Grass Creek on the west side of the Big Horn River and crosses the river in a flume a few miles below. This canal will reclaim about 17,000 acres of land, 10,682.53 acres of which has been segregated under the Carey Act.

The second canal diverts water from the east bank of the Big Horn River a short distance above the mouth of No Water Creek and covers between 13,000 and 14,000 acres of deeded land. The Chicago, Burlington and Quincy Railroad runs through a large body of this land. The land under the Carey Act is sold for \$30.50 per acre, including a perpetual water right and an interest in the irrigation works. The elevation is about 4,500 feet. (Fig. 12.)

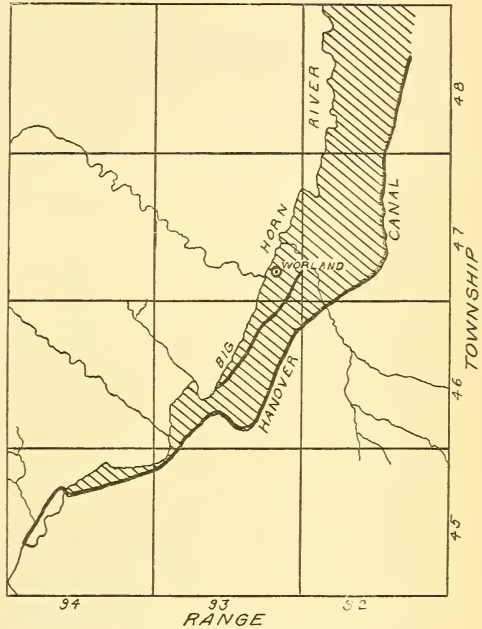


FIG. 12.—Hanover Canal.

BIG HORN COUNTY CANAL, BASIN, WYOMING.

[T. 49 N., R. 93 W.]

The Big Horn County Canal diverts water from the west bank of the Big Horn River a few miles above the town of Worland. The lands all lie close to the river. About 22,000 acres can be reclaimed under this system, which has been completed at an expense of nearly \$400,000.

The elevation of the country is approximately 4,500 feet. The lands to be reclaimed are largely tributary to Basin, the county seat of Big Horn County. None of the land is more than 3 or 4 miles from the line of the Burlington Railroad. These lands can be

obtained, together with a perpetual water right and an interest in the irrigation works, for \$40.50 per acre. (Fig. 13.)

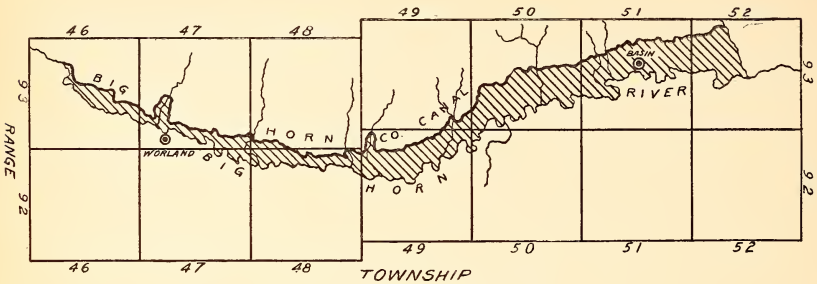


FIG. 13.—Big Horn County Canal.

PAINT ROCK AND SHELL CREEK CANALS.

[T. 52 N., R. 92 W.]

The Wyoming Land and Irrigation Company has planned two canals, one to divert water from Paint Rock Creek in T. 49 N., R. 90 W., and the other from Shell Creek in T. 53 N., R. 91 W. Fifty-four thousand acres has been segregated under the Carey Act and a considerable area of patented lands will be covered by these canals.

Several lakes in the Big Horn Mountains will be utilized for reservoirs in connection with this project. Construction has already commenced and it is estimated that some 10,000 to 15,000 acres will be ready for the settlers in the spring of 1909. These lands lie at an elevation ranging from 3,600 to 4,200 feet. This part of the State has been found well

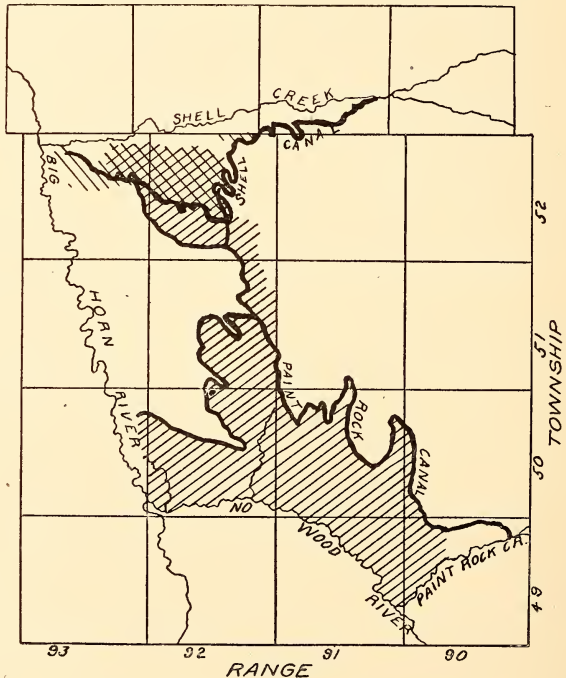


FIG. 14.—Paint Rock and Shell Creek canals.

adapted to the raising of fruit, and a large area under this project will probably be devoted to that branch of agriculture. (Fig. 14.)

MEDICINE WHEEL CANAL, TENSLEEP, WYOMING.

[T. 56 N., R. 94 W.]

This project lies on the east side of the Big Horn River in Tps. 56 and 57 N. Under the provisions of the Carey Act 22,500 acres have been segregated. The water supply is to be derived from Porcupine Creek, a tributary of the Big Horn River. These lands lie at an altitude of about 4,200 feet. Actual construction has not yet begun on this project. (Fig. 15.)

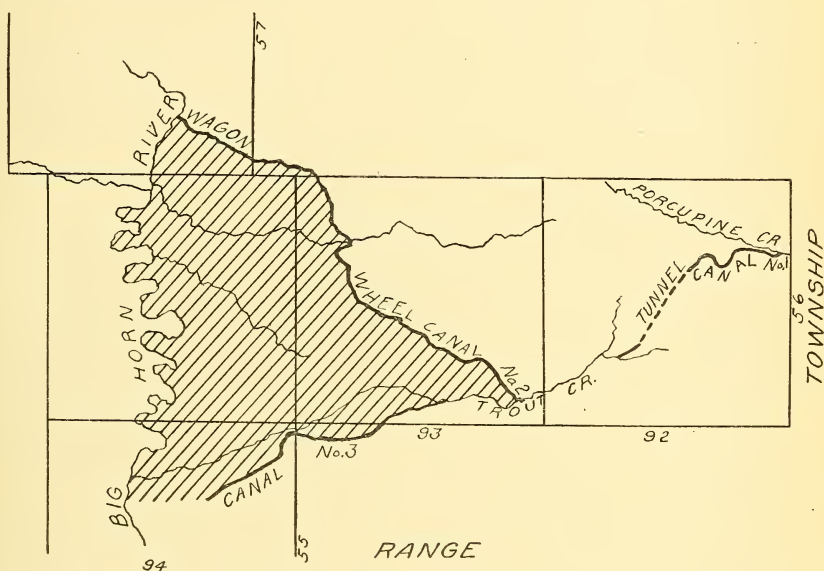


FIG. 15.—Wagon Wheel Canal.

SIDON AND LOVELL CANALS, BYRON, WYOMING.

[T. 56 N., R. 96 W.]

About the time the Burlington Railroad entered Big Horn County with its construction forces a small party of Mormon immigrants settled on lands lying north of the Shoshone River and east of Garland. Without great means they began the construction of the Sidon Canal. By obtaining work on the railroad and by such cooperation as is seldom seen anywhere except in Mormon communities their plans were finally carried to completion.

An excellent canal was built to reclaim some 20,000 acres of land segregated under the Carey Act. The canal derives its supply of

water from the Shoshone River, as does the Lovell Canal, which irrigates 5,000 or 6,000 acres of land on the south side of the river. These lands have all been taken up and the towns of Byron, Lovell, and Cowley have all come into existence as the result of agricultural development. The Lovell Irrigation Company, which built the Lovell Canal, proposes to reclaim additional lands, and in all 11,320.51 acres have been segregated. The elevation of these lands is about 3,800 feet. (Fig. 16.)

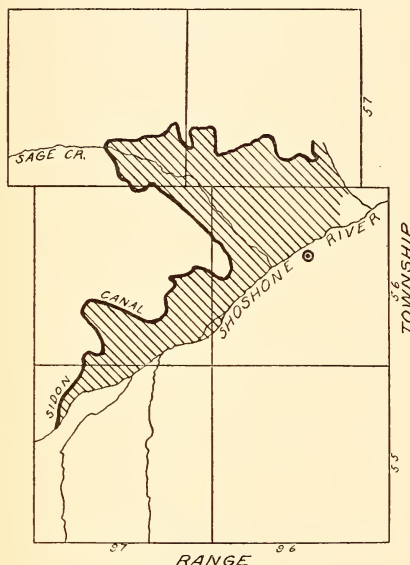


FIG. 16.—Sidon Canal.

under the provisions of the Carey Act. The altitude is about 5,000 feet.

HAMMITT DITCH, CODY, WYOMING.

[T. 51 N., R. 103 W.]

This ditch is to divert water from the South Fork of the Shoshone River above the headwaters of the Cody Canal and the Shoshone River Canal. An application for the segregation of 7,000 acres of land has been made and work will doubtless be commenced on the canal as soon as the land is set aside

SHOSHONE PROJECT OF UNITED STATES RECLAMATION SERVICE.

[T. 55 N., R. 99 W.]

The Government work on Shoshone River consists in the construction of a reservoir located at the junction of the north and south forks, two canals taking water from the north bank and one from the south bank of the stream. These canals will lead to the reclamation of all irrigable land on the north side of the Shoshone River between the mouth of the canyon above Cody and the Sidon Canal.

The reservoir dam will be the highest in the world, and it is anticipated that this will be completed by the 1st of January, 1909. One of the large canals diverting water from the north side of the river has been almost completed. This diverts water at Corbett, 7 miles east of Cody. The canal runs in a northerly direction for 12 miles, thence northeasterly for 35 miles. The work was far enough along the present season to warrant an invitation being extended to the prospective settlers and 13,000 acres have been thrown open. This area will be rapidly increased during the next year or two. Condi-

tions governing settlement can be ascertained by writing the United States Reclamation Service, Washington, D. C. The land varies in elevation from 3,700 to 4,600 feet. (Fig. 17.)

OREGON BASIN PROJECT, WILEY, WYOMING.

[T. 51 N., R. 99 W.]

Under this project 204,620.53 acres have been segregated under the provisions of the Carey Act. The main supply canal, 28½ miles in length, is now under construction. When completed it will be 60 feet wide on the bottom and 10 feet in depth and capable of carry-

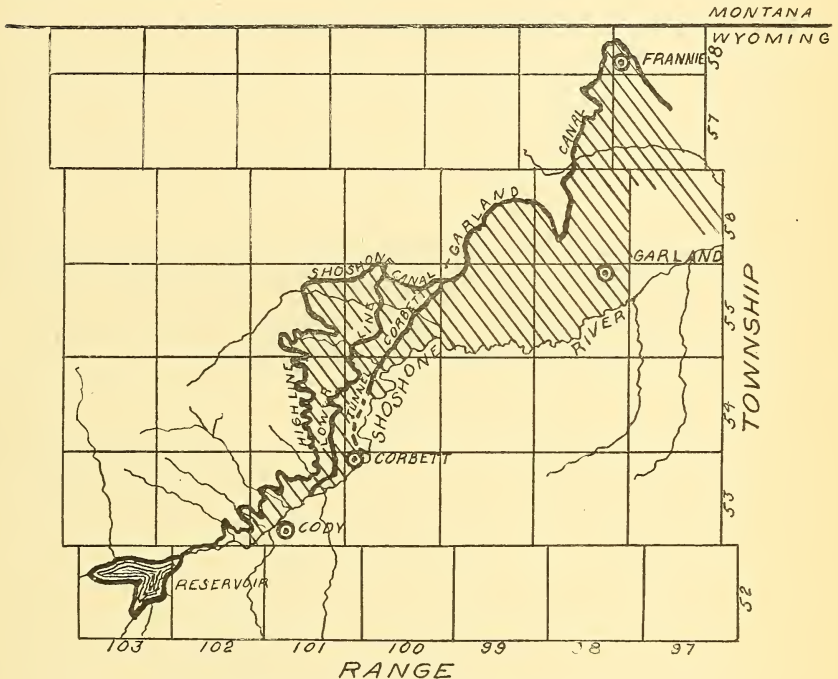


Fig. 17.—Shoshone project, United States Reclamation Service.

ing 2,000 cubic feet of water per second of time. This canal presents many difficulties in construction, but work is going steadily forward and water will be supplied to the land embraced in this project within a year or so.

The extremely attractive feature of this project is the Oregon Basin Reservoir site. This is a natural basin located at the end of the supply canal about 12 miles southeast of Cody. This site will store nearly 500,000 acre-feet of water without any embankment. The water will be drawn off through a tunnel in solid sandstone. The lands of this project run from the Oregon Basin Reservoir easterly for 50 or 60 miles and vary in elevation from 4,000 to 5,000 feet. The soil is of first-class quality and the climatic conditions are favor-

able to rapid development when water is supplied. The cost of land and water rights and a permanent interest in irrigation works will run from \$30 to \$40.50 per acre. This company has already completed one canal, the Bench Canal, taking water from the Grey Bull River

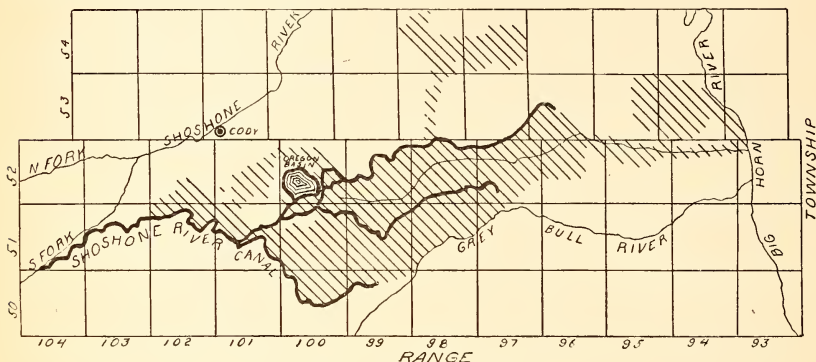


FIG. 18.—Oregon Basin project.

River. This canal diverts water from the Grey Bull River and two prosperous towns, Germania and Burlington, have sprung up thereunder. (Fig. 18.)

HUBBARD CANAL, CODY, WYOMING.

[T. 57 N., R. 101 W.]

The builders of this canal have applied for a segregation of 36,621 acres of land lying on the east side of Clarke's Fork River north of

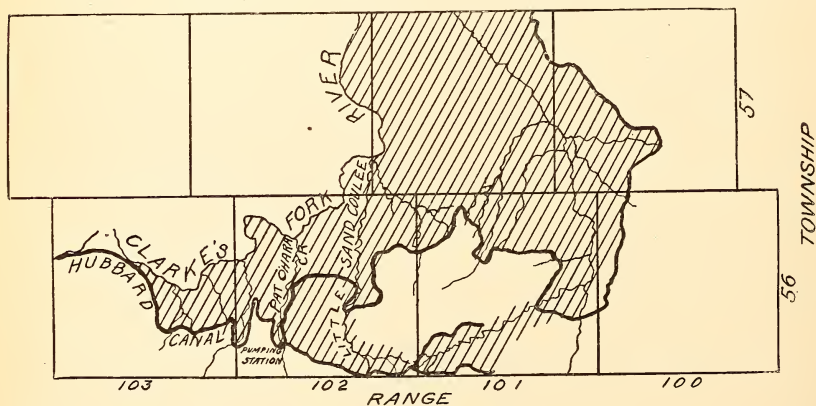


FIG. 19.—Hubbard Canal.

Cody. Work on this project has not yet begun, but construction will doubtless be commenced as soon as all preliminary arrangements have been completed. These lands are at an altitude of from 4,000 to 5,000 feet. (Fig. 19.)

CODY CANAL, CODY, WYOMING.

[T. 52 N., R. 102 W.]

The Cody Canal takes water from the South Fork of the Shoshone River and reclaims land lying south of Cedar Mountain and in the vicinity of Cody, a town which has sprung up largely by reason of the agricultural community surrounding it.

When this canal was begun there were no railroads in Big Horn County. All supplies were brought in by wagon from Red Lodge, Mont., a distance of 60 miles. This project was not only the first Carey Act undertaking in Wyoming, but was the first enterprise initiated under the National statutes. It has probably afforded more instruction to those interested in work of this kind than any other undertaking. The first segregation embraced an area of 26,429.94 acres. Some of these lands have been found too rough for reclamation, and about 13,000 will ultimately be irrigated. At the present time fully 10,000 acres are under irrigation and the settlers are prosperous and well contented. Their lands have an elevation of about 5,200 feet.

The great Government works, which are located in the canyon 6 or 7 miles west of Cody and on the north side of the river

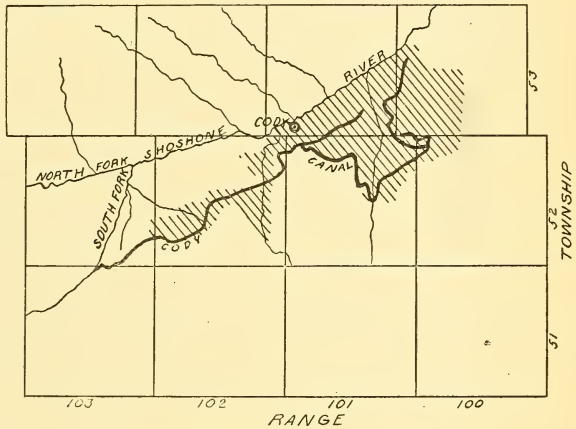


FIG. 20.—Cody Canal.

extending as far as Garland, have assisted materially in the last few years in making farming under the Cody Canal profitable. A great market has been furnished at all times for everything grown and opportunities for work during the winter season have always been provided. Several thousand acres of land are still open to entry in this tract. The canal system was finally accepted by the State and the management turned over to the irrigators about a year ago. All the business arrangements are now in the hands of the people who use the water and own the lands. (Fig. 20.)

EDEN CANALS, ROCK SPRINGS, WYOMING.

[T. 25 N., R. 106 W.]

This project lies in Sweetwater and southern Fremont counties. A tract of 92,606 acres has been segregated under the Carey Act, and

it is proposed to build a series of canals taking water from Big and Little Sandy rivers a few miles above their junction. Two reservoirs are planned, one of which has been completed, as has Canal No. 1, which diverts water from the Big Sandy River in T. 27 N., R. 106 W. The large reservoir lies toward the headwaters of the Big Sandy and it will be filled by that stream, and also by a diversion from Little

Sandy River. About 15,000 acres are already under ditch and ready for the settlers. These lands lie at an elevation of about 6,600 feet. (Fig. 21.)

BOULDER CANAL, BOULDER,
WYOMING.

[T. 32 N., R. 108 W.]

The southwestern slopes of the Wind River Mountains form a country of lakes. Among these natural bodies of water is Boulder Lake, from which Boulder Creek, an important tributary of New Fork River, carries a large stream. The water from this stream has been diverted by the Boulder Canal and Reservoir Company for the irrigation of 6,120 acres of lands segregated under the Carey Act.

This region promises to become important from an agricultural standpoint. While the altitude will doubtless prevent the growing of such crops as

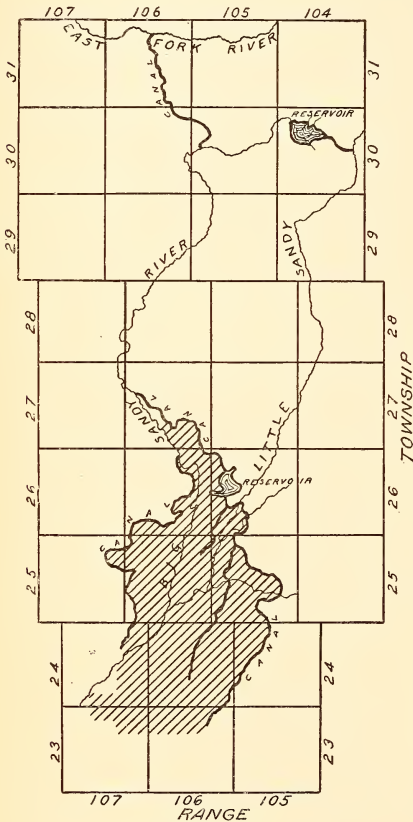
corn, all other cereals and forage crops can be produced. The elevation of these lands is about 6,700 feet.

GREEN RIVER CANALS, GREEN RIVER, WYOMING.

[T. 23 N., R. 110 W.]

For a number of years various parties have been interested in the reclamation of lands along Green River. These lands lie at an elevation varying from 6,300 to 7,000 feet.

During the spring of 1908 permits were issued to the Green River Land and Irrigation Company (Limited) for the Green River Canal,



diverting water from the west bank of Green River just above the mouth of Fontenelle Creek. The canal crosses Green River some 12 miles below there, to reclaim 97,474.53 acres lying between Green River and the Big Sandy River.

An application for the segregation of these lands under the Carey Act has been filed with the State board of land commissioners.

Surveys have also been made for a canal on the west side of the river which will reclaim 50,000 or 60,000 acres northwest of the city of Green River. A third canal diverting water on the west bank of Green River near the mouth of Horse Creek in T. 34 N., R. 111 W., has been surveyed and permits will doubtless be issued within the next few months. This canal will reclaim about 125,000 acres of land. (Fig. 22.)

UTAH AND WYOMING CANAL.

[T. 15 N., R. 116 W.]

This project is located in the southwestern part of Uinta County. Water is to be taken from Black Fork, and a reservoir site in Utah provides storage. An application for the segregation of 20,000 acres under the Carey Act has been made. Work will doubtless begin on this project as soon as the lands have been set apart for the purpose of reclamation. The elevation of this land is about 6,700 feet.

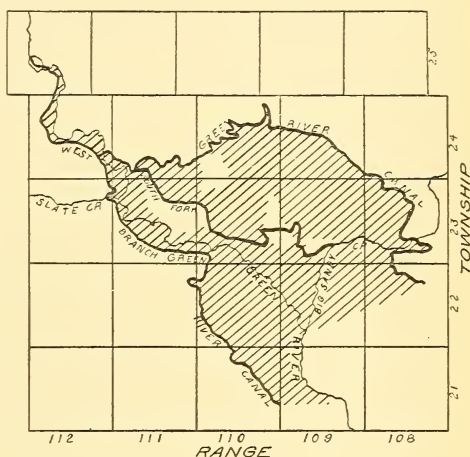


FIG. 22.—Proposed Green River Canal.

THE SETTLEMENT OF LANDS UNDER IRRIGATION SYSTEMS.

To the prospective farmer some information as to what he should possess in a worldly way before embarking upon this new life is important. What he lacks in good health and physical vigor he will soon recover by the exercise of the first few years on the irrigated farm. Many a successful farmer in Wyoming arrived in the State with good health and an inclination to work as his only assets. These are the main essentials, except certain moral qualifications on which all success depends.

The settler will find that his living expenses for the first year are higher than he has estimated. It may be that he will be obliged to

invest more in his dwelling than he had at first thought to be necessary. Misfortune in small matters may disturb his early estimates. He will always have to provide a house, which he may not pay for at once. As it must be paid for at some time the item should be included. This will cost from \$300 to \$3,000, depending upon the ability of the farmer. The average cost of the first house built on a new farm does not exceed \$450. The barn will cost \$200 and a shed for tools \$100. The necessary tools, such as plows, harrows, drills, mowers and binders, together with wagons, horses, harness, one cow, shovels, forks, etc., will cost from \$800 to \$1,500, the average being probably \$1,100. To fence 160 acres of land with a four-wire barbed-wire fence, posts of cedar, 40 feet apart and brackets each 10 feet will cost \$400. A capital of \$2,500 would be sufficient for a settler provided he had enough money in addition to pay the first and second installments on his land and water right. On 160 acres this payment would average \$550 per annum. While this capital is a great assistance, yet a beginning can be made on a much smaller sum and result in a great ultimate success. The settler who takes land under a large irrigation system must have means sufficient to enable him to live for the first year or two and meet his payments. His property increases much more rapidly in value under these conditions than it does where a homestead is isolated. The proximity of neighbors and the advantages of society appeal to most men, so that the added responsibilities placed on those who become a part of a great agricultural community are all compensated for.

The cost of preparing ground for irrigation varies greatly with the character of the soil, the kind of natural vegetation and extent of growth, the general slope of the country, and the extent of broken and rough land. A soil that contains much sand must be handled carefully or it will wash. Where the soil is of such character that the surface will break after being irrigated it is often necessary to apply the water in small furrows from two to three feet apart and not permit the water to spread over the entire surface. Where heavy sagebrush, greasewood, or willows are growing much time and labor are often necessary to clear the ground. Where heavy sagebrush grows the land is worth all it costs to clear the surface. It might be a question in some instances where greasewood and willows have to be grubbed. Lands having steep slopes are difficult to irrigate and the lateral system must be laid out with great care. Broken and rough land may have to be graded in places and where this is necessary it may cost from \$5 to \$15 per acre. Under large canals, where there are tracts of such land, some companies provide a decreasing scale of water-right prices, so that the settler in improving his lands really works out a part of his water-right charges. This is probably the best solution of the broken-land problem. It is not good business

management to permit these lands to lie idle until all surrounding lands have so increased in value that it will pay to purchase water rights and perform the necessary improvement work at the same time.

The following estimates relating to the settlement of irrigable lands have been submitted to the State engineer by parties representing different projects:

THE NORTH PLATTE CANAL AND COLONIZATION COMPANY.

(1) Labor and expense necessary on the part of settlers to prepare the land for water and to establish a home vary according to the location. All that I am familiar with is lands under the project of the North Platte Canal and Colonization Company Canal. As there is no sagebrush on any of the lands being settled by this company there is nothing to do but break and level the ground. Breaking costs from \$2 to \$2.50 per acre, and disking and leveling, which we think necessary to attain the best results, would cost as much, making probably \$5 per acre.

(2) Funds and equipment required to make a successful start: Settler should have not less than \$2,500 to \$3,000 for 160 acres of our Carey Act land; for 80 acres, from \$1,500 to \$2,000, as the cost is more in proportion on 80 acres than on 160, the same improvements being required for 80 acres as for 160, except for breaking, fencing, leveling, and seeding.

(3) Opportunities for settlement: We still have a few thousand acres of land that are available for settlement.

(4) Class of settlers desired: Our experience has been that settlers coming from and having had some experience in other irrigated sections make the most desirable settlers, though we have had good results from practical farmers from all sections. Those who are not making a success of farming in this part of the North Platte Valley are those who have had practically no experience at all in agricultural work.

THE WYOMING CENTRAL IRRIGATION COMPANY.

I will confine my answer to the Wind River, or Shoshone, Indian Reservation, recently thrown open for settlement.

We have here 350,000 acres of land lying under a projected reservoir and canal system, 15,000 acres of which is covered by a canal and has practically had two seasons' experience, so that I speak from that length of experience by the settlers here.

Some of the land is black sagebrush land and some is salt sagebrush land. The cost of preparing these two classes of land is materially different. The black sage can be cleared from the land, with proper appliances, by contract labor for about \$2 per acre. If the farmer has his own teams and appliances, this clearing can be done for about from \$1.50 to \$1.75 per acre. The salt sage land does not need to be cleared.

It costs \$2 per acre to plow the land.

Experiments made here the past two years have demonstrated the fact that for the first crop of grain the land does not need to be plowed.

On the black sage land, after the sagebrush is cleared, and on the salt sage land, without any clearing whatsoever, oats can be sown broadcast and disked in at about the same cost as for drilling oats on plowed ground—about \$1 per acre.

It has been proven by long experience of old settlers in the Lander Valley and by a year's trial here that for the purpose of preparing land for alfalfa it is better to raise a grain or potato crop the first year and plant alfalfa by itself the second year. The old idea of a nurse crop for alfalfa is a mistake. The land should be leveled and smoothed in preparing it for alfalfa. The cost of doing so here, after clearing the sagebrush and plowing the land, is about 50 cents per acre.

Fencing, where done by contract labor, costs about \$100 per mile for a three-wire fence, posts two rods apart with two stays between, which constitutes a legal fence.

I estimate that a man can himself, with four horses, prepare and put in crop the first year 80 acres of land, and the second year prepare the additional 80 acres and crop the entire 160 acres by the employment of one or two men for a period of about four months.

With proper farming operations the lands here will net, according to the various crops raised, from \$20 to \$40 per acre per year.

A settler to make a successful start and not lose time, but begin to reap the benefits of his average income from his entire acreage, for 160 acres of land should have four horses, a wagon, a two or three disk plow, harrow, moldboard plow, scraper, seeder, rake, mowing machine, reaper, and \$2,000, either in cash or credit, with which to construct first buildings, purchase seed, and make first payment on his water right. With such an equipment and a little extra energy, if he begins operations in the fall, he should be able to put his entire 160 acres into crop. Fall plowing will make a very considerable difference in the crops over spring plowing, besides giving the farmer an opportunity in the spring simply to get his crop in early and in a satisfactory way and be ready to apply the water for irrigation.

There are 350,000 acres of land open for settlement under the homestead act, the land costing the settler \$1.25 per acre, and water on five years' time—one-fifth down and the balance in five equal annual payments—at \$25 per acre; or at \$30 per acre on ten years' time, one-tenth down and the balance in ten equal annual payments.

The class of settlers desired here are such as can successfully raise grains, alfalfa, potatoes, sugar beets, and fruit, and who understand the fattening of live stock, particularly sheep and pigs.

BIGHORN COUNTY IRRIGATION COMPANY.

It has been our experience that the labor and expense necessary to prepare land for a home on the part of a settler amount to about \$3 per acre, for the clearing, plowing, and seeding of the land. This expense is based on the supposition that the land is salt sage and not black sage. Such being the case the settler can plow and disk the same without preliminary clearing. The house, of course, varies in cost as to size and material. A very convenient and useful house can be built for \$200, which will be comfortable in all kinds of weather.

To make a successful start the settler should have sufficient funds to make the first payment on his water contract and to build a house and prepare a certain portion of his land for crop. With a year's time in which to make the second payment on his land contract he should be in good shape to make his land pay for itself.

The opportunities for settlement in this section are numerous. There are irrigation projects within a radius of 60 miles which offer the settler almost every conceivable kind of proposition, from the Government canal where the settler is required to live on the land for five years, his payments being scattered over a period of ten years without interest, to the Carey Act propositions which require only a thirty days' occupancy and a certain amount of reclamation of the land, the payments on land and water right being payable in five or ten years' time.

There are also some deeded ranches to be had in this section, which are sold almost always for cash.

It has been our experience that no matter from what section of the country settlers come or of what nationality, they all make good citizens and good farmers if they are willing to work and apply themselves diligently to their work.

THE WYOMING DEVELOPMENT COMPANY.

(1) To break, make a good seed bed, and make distribution laterals from an irrigation system, figure \$6 an acre.

(2) Say \$300 for a good cabin (the first home); barn, etc., team, wagon, agricultural machinery, \$600. It costs, as you know, nearly as much for a man to get ready to farm as the cost of getting unimproved watered land, unless the man wants a large farm. Everything seems to depend upon the man himself. A thrifty man and wife will spend but little during the first four or five years. At the end of that time, as a rule, it will be found that they will have a fairly good home, good barn, some stock and their 80 acres looking well improved. The unthrifty man reverses the rule.

(3) There are splendid opportunities for farmers to make good homes. They have a great advantage over the farmers in the Mississippi Valley for the reason that they can get a good price always for what they produce from their land, especially for hay, grain, and the more important root crops.

(4) The ideal class of settlers for any country is a class of people who have made success elsewhere and have accumulated a little capital. They must have some capital of their own or borrow it. A settler must live for one year before he can produce much on his farm. His time for twelve months will be occupied in getting ready to produce something. Largely for this reason it has been said repeatedly that the first comer is of little value to a new country.

THE SAHARA DITCH COMPANY.

Where a party settles upon 160 acres, and does the bulk of the work himself, I would estimate the amount of money necessary to establish himself about as follows:

Cost of good standard fence.....	\$100
Cabin.....	250
Team, wagon, and harness.....	450
Cash for tools, seed, and living expenses first year.....	500
Total.....	1,300

In case alfalfa was sown with the grain, it would be necessary to add, say, \$3 an acre for the alfalfa seed.

THE PIONEER CANAL COMPANY.

Conditions vary so greatly in the same and different localities, depending upon the settler, the soil, the topography of the land, the degree of thoroughness employed, etc., that there can hardly be said to be any criteria which would be useful to intending settlers under such varying circumstances. However, in my judgment, your questions may be answered as follows:

(1) The labor and expense necessary to prepare the land for water and to establish a home may be put down at \$7.50 per acre for the land to be cultivated (plowed land) or \$5 per acre for unplowed land, which figures do not include any cost of clearing the land of sagebrush and greasewood, nor for leveling uneven land. The additional expense of establishing a home, including the building of a dwelling house, stable, corral, and fencing from \$250 to \$1,000 for the most modest kind of an establishment.

(2) The amount of funds and equipment necessary to make a successful start depend almost wholly upon the character and capacity of the settler. I should say that this would vary from \$250 to \$2,500 without taking in extremes on either side.

(3) There are very good opportunities, indeed, for settlement in this region of the country, either for homesteaders who wish to take up free Government land or for those who care to invest in private land at from \$1 to \$5 per acre. I speak of such opportunities as unusually good because the land is to be had at any desired price with all the advantages of comparatively old-settled communities and with good markets and transportation facilities.

(4) I think the class of settlers most desired here is the farming class, as the live-stock industries here have been for many years undergoing and are still undergoing a gradual transition from open-range propositions to close settlement which offers exceptionally good opportunities for stock farming, also dairying and truck and grain farming.

LAWS GOVERNING THE CONTROL AND USE OF WATER.

The constitution of Wyoming provides for the control of surface waters by the State. It also creates the office of State engineer and divides the State into four great water divisions, which are to be under the control of division superintendents. The four division superintendents, with the State engineer as president, form the board of control, which, in the terms of the constitution, "shall, under such regulations as may be prescribed by law, have the supervision of the waters of the State, and of their appropriation, distribution and diversion, and of the various officers connected therewith, its decisions to be subject to review by the courts of the State." The constitution also establishes the doctrine of priority of right.

STATE ENGINEER.

The State has accepted the responsibility placed upon it by the constitution by the enactment of laws which carry out the provisions thereof. Under the law, the State engineer is required to measure streams, to collect facts and make surveys to determine the best method of utilizing the waters of the State, and to ascertain the location of lands best suited to reclamation. He is also required to examine reservoir sites, and in his biennial report to the governor he must embody all of the official information of this character he may collect. He also recommends to the governor such changes in the existing law as he deems should be made by the legislature. He is provided with an assistant and additional funds for the employment of engineering help. In connection with his duties under the direction of the State board of land commissioners he is furnished with a deputy engineer who performs work relating to the reclamation of lands under the provisions of the Carey Act. He is required to collect certain fees for filing and recording papers and for furnishing certified copies of the same, all such moneys being deposited with the State treasurer on the first Monday of each month.

Rights to use water are initiated in the office of the State engineer. They are determined by the board of control. Any person desiring to use water first has surveys made which set forth the location and purpose of the proposed use. An application for permit covering such use is then prepared. This application must contain the name and post-office address of the applicant, the source of the water supply, the nature of the proposed use, the location and description of the proposed ditch, canal, or other works, the time within which it is

proposed to begin construction, the time required for the completion of construction, and the time necessary for the application of the water to the proposed beneficial use. Where irrigation is proposed the application must contain a description of lands to be reclaimed. Any person who uses water without compliance with the law is deemed guilty of a misdemeanor and can be punished therefor. The application for permit, together with maps and plans in duplicate, is then sent to the State engineer, who files it, giving it such filing date as is fixed by the time of its receipt, which establishes the priority of the right should a right accrue under the permit issued. He must examine the application and ascertain whether or not it complies with the law. If defective he must return it for correction. A record is kept showing what action is taken in all instances, whether the application is returned for correction, or is approved or rejected. The discretion of the engineer in approving or rejecting applications for permit is plainly set forth in the law. It reads:

It shall be the duty of the State engineer to approve all applications made in proper form which contemplate the application of the water to a beneficial use and where the proposed use does not tend to impair the value of existing rights or be otherwise detrimental to the public welfare; but where there is no unappropriated water in the proposed source of supply, or where the proposed use conflicts with existing rights, or threatens to prove detrimental to public interest, it shall be the duty of the State engineer to reject such application and refuse to issue the permit asked for.

Before action is taken regarding an application for permit the State engineer may inquire into the financial ability of the applicant and seek all information that can be obtained as to whether the applicant is acting in good faith. Under all permits issued the work of construction must begin within a year from the date of approval of the application. No applicant is given more than five years to complete construction, but, for good cause shown, the State engineer may extend the time at a subsequent date. Any person feeling himself aggrieved by any such action of the State engineer may appeal to the board of control and from the board to the courts.

The law contains strict specifications regarding the maps which are to be filed with applications for permits. These have to be carefully inspected and returned if defective. When an application is approved, a duplicate of the map is approved and sent back to the applicant with the permit; the permit is recorded and the original map is filed in the office of the State engineer.

Practically all permits issued are for irrigation purposes. As water becomes more fully used from any stream storage works are built. A different form of application for permit is used in connection with reservoirs. The application for permit in this instance must contain many of the same details that are required in the case of a canal and the additional information concerning storage capacity, character of dam, spillway outlet, etc., is added. Under reservoir permits the

final right to use the stored water can be obtained only by the party who uses the water. The party who desires to use some of the stored water secures a canal permit, called a secondary permit in this case, while the reservoir permit is called the primary permit. The secondary permit is not issued by the State engineer until the applicant therefor submits documentary evidence that he has bought or contracted for an interest in the storage works provided for the reclamation of the land described therein. This protects both the reservoir builder and the party who makes use of the water.

The State engineer has the authority to appoint an engineer to inspect all work during the construction of a reservoir, so that the public may be protected from damage that might be done by floods caused by the breaking of the dam. The construction agency is required to pay the engineer thus employed. The permit can be canceled by the State engineer unless his requirements in this direction are complied with.

All engineers and surveyors performing work relating to the preparation of an application for permit or in making plans providing for the utilization of the waters of the State must be licensed. The State engineer is a member of the board which examines candidates who desire to do this kind of work.

No timber can be driven on the streams of the State without first obtaining a permit for each season's drive and giving a bond to cover any damage that may be done to irrigation works or other improvements.

Before the establishment of the present system of issuing permits, many rights to water were acquired by appropriation and use, which were consequently undefined. The board of control is charged with the defining of such rights and the issuing of certificates in accordance with its findings. Prior to the adjudication of the rights to water from any stream by the board of control, the State engineer makes a survey of all ditches, showing on the maps prepared thereafter the location of the natural streams and the canals, water courses, lakes, and reservoirs, together with the location and extent of all lands irrigated in each 40-acre tract.

The engineer must also pass upon all projects taken up under the provisions of the Carey Act, and must inspect works during construction and prior to final acceptance by the State engineer before being sent to the county commissioners for approval.

WATER DIVISIONS AND DIVISION SUPERINTENDENTS.

The State is naturally divided into four great drainage basins, and these are made separate divisions for administrative purposes. These are defined in the law as follows (Pl. III, p. 16):

SEC. 848. The State of Wyoming is hereby divided into four water divisions, as follows:

Water Division No. 1 shall consist of all lands within this State drained by the North Platte River and the tributaries of the North Platte River and the South Platte River, Snake River (a tributary of Green River) and its tributaries, and Running Water Creek and its tributaries.

Water Division No. 2 shall consist of all lands within this State drained by the tributaries of the Yellowstone and Missouri rivers north of the watershed of the North Platte River and Running Water Creek and east of the summit of the Big Horn Mountains.

Water Division No. 3 shall consist of all lands within this State drained by the Big Horn River and its tributaries and by Clarks Fork and its tributaries.

Water Division No. 4 shall consist of all lands within this State drained by the Green, Bear, and Snake rivers and the tributaries thereof, except Snake River (a tributary of Green River) and its tributaries.

A division superintendent has charge of each division. He is appointed by the governor for a term of four years. To enable the governor to judge as to the merits of candidates for these positions the State engineer is required by law to conduct examinations from time to time and to file the names of those who qualify in the office of the governor. The division superintendents have general charge of the water commissioners, the police officers of their respective divisions. Each division is divided into districts, in each of which a water commissioner has control of the diversion and distribution of water in accordance with the decrees furnished by the board of control. The superintendents are responsible for the execution of the law relating to the diversion and division of water, and instruct water commissioners and take active part themselves in the field work during times of scarcity of water. The superintendents are also required to perform any special public service which may be assigned them by the State engineer.

To enable the superintendents to make the best use of water during times of scarcity, they are authorized to make regulations which supplement the provisions of the law. Any person may appeal from a decision of a superintendent to the State engineer. As all recognize that these officers are working for the public good and that they have no personal interest in the division of water, an appeal is very rare.

The work of the superintendent is of great value to the water users. He travels over his division at least once each year. Through him the irrigator is able to deal directly with the board of control and each individual case is studied on the ground, so that when a matter comes to the board a personal and accurate knowledge of conditions is submitted.

BOARD OF CONTROL.

As before stated, the board of control consists of the four division superintendents and the State engineer. It meets regularly on the

second Wednesday of April and the third Wednesday of November each year and holds special meetings should the business before it require. The State engineer, as president, has a right to vote on all questions and a majority of the board constitutes a quorum. The board is authorized to employ a secretary, who keeps the minutes of all meetings, prepares, under the instructions of the board, the orders, decrees, and tabulations of rights to use water, certifies under seal all certificates of rights, and performs such other duties as may be required by the board.

The duties of the board relate chiefly to the establishment of rights to use water acquired prior to the establishment of the present system of issuing permits. When a stream is taken up for adjudication, the superintendent of the proper division sends notices to all users informing them when the State engineer will begin his surveys and when he will begin the taking of proofs. When the surveys are finished and maps have been prepared showing the location of ditches, reservoirs, all natural water courses, and the irrigated lands, the superintendent goes into the field and meets the people at convenient places, where each user submits proof as to the character and extent of his use. The principal points in determining a right are the date when water was first used, diligence in development of use, extent of use, character of works built to utilize the water, and the character of the supply. The blank forms used by the superintendents are calculated to bring out this information. While proof is being submitted the maps prepared by the State engineer are consulted and in most cases the engineer who performed the field work under the supervision of the State engineer is present. In this way but little opportunity for errors is given. The claimants are required to bring their land patents or deeds and to supply such information as will show that they are correct in the dates they give as to the time water was used.

When all proofs have been submitted the superintendent returns to his office and prepares a tabulation showing the various rights to use water as fixed by the proofs submitted to him. He then sets a time for submitting all these proofs for inspection by all interested parties, any of whom may contest any claims made by other water users. All contests must be filed within fifteen days from the date of public inspection. The contests, if any arise, are heard before the superintendent, each party to the contests depositing \$8 per day for each day occupied in the work. The party who is successful in the contest is reimbursed after the matter has been finally decided, while the money paid by the party who loses is deposited in the State treasury. This procedure was inserted in the law to discourage contests which arise often through neighborhood ill-feeling,

when there may be no reason for a difference regarding rights to use water. The plan has worked well in practice.

After all contests have been heard the superintendent takes all the records of adjudication, contests, surveys, and his tabulation and prepares a report of his work. All is then submitted to the board of control at a regular meeting. The board inspects the work of the superintendent, decides finally the contests, orders the fees to be paid in accordance with the provisions of the law, and then prepares an order which sets forth the right of each party, dedicating such right to the use already made thereof. The minutes of the board recount the work performed in detail. After the decree of the board has been regularly entered and signed, the certificates of rights are issued, signed by the president and attested by the secretary. These certificates are all recorded in the office of the secretary and the original of each is mailed to the clerk of the county in which the water is used, where it is recorded again and then mailed to the water user. The legal fee is collected by the division superintendent at the time the proof of appropriation is taken and the secretary of the board deposits \$1 for each certificate in the State treasury and sends \$1 to the county clerk for recording the certificate in his office.

While the certificates define the rights of use, yet during times of scarcity the superintendents and water commissioners are governed largely by the terms of the law, which read as follows:

Provided, That such appropriator shall at no time be entitled to the use of more water than he can make a beneficial application of on the lands for the benefit of which the appropriation may have been secured, and the amount of any appropriation made by reason of an enlargement of distributing works shall be determined in like manner: *Provided*, That no allotment shall exceed 1 cubic foot per second for each 70 acres of land for which said appropriation shall be made.

An appeal may be taken from the order of the board of control to the district court of the county in which the water is used, or if in more than one county, the board designates the county in which the case shall be tried. All such appeals are advanced on the docket of the court, thus providing, in so far as is possible, a speedy determination of the rights. When the court acts, the clerk of the court is required to send a certified copy of the decree to the board of control. Any party may obtain a rehearing before the board of control within a year by making proper petition showing that evidence not obtainable in the initial submission of proof is available. All persons who have been regularly notified by registered mail and who have received such notice must abide by the decision of the board, subject to appeal to the court within sixty days or a rehearing for causes above given. Those who have not been notified may, within one year, petition to have the decree reopened. If it is found that the petition in such a case is based on fact, the decree is reopened and

the right established, after notice has been given to all other users and opportunity given for contests as in the original adjudication.

After a stream has been adjudicated proofs under permits are taken as rapidly as irrigation works are completed, and water used in accordance with the conditions of such permits. An inspection is made by the superintendent on the ground before taking proofs of this kind.

It often happens that rights to water from tributaries are adjudicated long prior to the settlement of rights to use water from the main streams. As tributaries affect the flow in the streams into which they flow, any party using water from such a main stream may, after all have been adjudicated and at a time fixed by the board of control, contest any right which has been established to his injury.

WATER COMMISSIONERS.

While the State is divided into water divisions by law, these are subdivided into districts by order of the board of control and a commissioner for each appointed. Water commissioners are required to police the streams; to see that the water goes to those entitled to it; to see that the orders of the board of control and specific directions of the superintendent are carried into effect; to regulate the use of water under partnership ditches where the various owners of the ditch can not agree as to the division that should be made; to attach to all head gates and controlling works notices that the same are in his charge; to see to it that reservoir water reaches the ditch which has the right to divert it; to guard against waste, and to see that water is used beneficially. Appeal may be taken from any act of a commissioner to the superintendent of his division and from the superintendent to the State engineer and the district court. Assistants can be employed to aid the commissioners in times of emergency.

Water commissioners are employed only when their services are needed. In some places the demand for such work is continuous and the county in which the stream may be located pays a salary from the beginning to the end of the irrigation season. A water commissioner can be called out at any time during the irrigation season by a written petition addressed to him by a water user. They are required to report to the superintendent and can not obtain pay for their services except upon approval of the superintendent, having shown him that they have worked only after having been requested in writing to do so.

Any person who interferes with the work of a commissioner by changing head gates or division boxes is deemed guilty of a misdemeanor and can be punished accordingly. The use of water when denied by a water commissioner is *prima facie* evidence of the party

so using it having changed the gates controlling it. The water commissioners have the power to arrest any persons offending and turn them over to the sheriff of the proper county.

In all measurements of water the cubic foot per second of time is the legal unit.

The law makes provision for a record of interests in irrigation works which, if taken advantage of, serves to protect all water users against future trouble in this direction. A provision has also been enacted into law whereby a water right may be transferred from one place to another. Owing to the complications in the procedure and the difficulties encountered on the ground this law has not yet been carried into effect completely in a single instance. Water users are generally informed as to the danger of such a proceeding, and when they consider the damage that may be done to others by such transfers they hesitate before trying to initiate them.

THE CAREY ACT.

Under various acts of Congress known as the Carey Act and amendments 2,000,000 acres of desert land have been donated to the State on condition that the same be reclaimed. Fully 800,000 acres are in process of reclamation under these acts in Wyoming at the present time. The company proposing to carry on such development first makes its surveys and plans for this work; then secures the necessary permits from the State engineer's office; then makes its request and proposal to the State board of land commissioners, composed of the governor, the secretary of state, and the superintendent of public instruction. This request and proposal describe the lands that are to be irrigated and contain the proposition of the company to the State as to price of water rights and a permanent interest in irrigation works, the form of contract to be used, and other particulars. If the State board of land commissioners approves of the proposition, maps and a request for the segregation of the lands are transmitted to the proper local land office. The lands designated are immediately withdrawn from entry and the local land office submits the request to the General Land Office at Washington, where the approval of the Secretary of the Interior finally places the State in control of the land. The works are then completed by the company. The land can not be taken up until the settler shows the State that he has entered into contract with the company for a sufficient water right for his lands and a perpetual interest in the irrigation works, proportioned in the ratio of the area of his land to the entire tract to be reclaimed. When the irrigation works are completed the State engineer makes an inspection, and, if they are found to comply with the plans and specifications which have been already passed upon by him, the State board of land commissioners is so notified; whereupon the board

makes a request to the Government that patent issue. The patent comes to the State and the lands are sold and patent given the settler upon the payment of 50 cents per acre, the payments for water rights being made to the company building the works.

THE DISTRICT LAW.

To enable the control of distribution to be localized, which is always a benefit to a community depending upon irrigation, and to permit such communities to improve irrigation works and increase the available supply of water the district law has been put into effect. A district may issue bonds and use the money thus secured in the improvement of the irrigation system on which its growth and material prosperity depends. Only the lands that are to be benefited by such expenditure may be included in the district. This has already been taken advantage of by one locality and another is making plans to the same end. The State engineer is required to pass upon the feasibility of the plans for the district, after which they are submitted to the county commissioners of the county in which the district is located.

FUTURE DEVELOPMENT IN IRRIGATED FARMING.

Wyoming has just entered the reservoir stage of her irrigation development. The great reservoirs now planned have to do with storing the water of the streams of considerable size, where the summer flow is not sufficient for all of the water users depending on the same source of supply. Storing this water is to have a marked effect on irrigation development, especially where storage works and irrigated lands are located well toward the headwaters of the streams. Holding large volumes of water until the irrigation season and then spreading it over the ground must lead to a gradual change in the flow of all natural streams. Rivers which formerly furnished large volumes of flood water during May and June and contained no water late in August have completely changed their characteristics below the storage works and irrigated lands. To-day no violent fluctuations in discharge occur. During the entire year a steady flow returns to the main stream from irrigated lands and the water rights of those living along the lower reaches of these rivers are of more value to-day than they were ten years ago, because the late summer flow is more abundant. This will be repeated on nearly every stream in the State. As the irrigator learns that strife with his neighbor over water does not increase the total available volume, but that it can result only in a different division of that volume at the expense of all parties concerned, he will get together with those who are not fully supplied during the late summer months and build storage works. This lesson has already been learned here and there and the district law will point the way for others to follow.

The reservoir storing water direct from the streams will then be followed by the smaller works which will store flood waters which run in ravines and gulches, thus providing water for detached areas above the lines of existing canals. As this water is used locally the return flow must have an important bearing on irrigation development at lower altitudes. In a country such as this, which is not strictly arid, it is difficult to estimate the total area that may be reclaimed by conserving and carefully using all of the water that falls and remains on the surface of the ground. Such a development problem has never yet been worked out in practice.

As intensive farming becomes general and as the best and fullest use is made of the available water supply, the laws governing such use must be modified to suit the new conditions. Some just method of dividing the water so that the individual will be protected and yet will be prevented from infringing on the rights and interests of the community will be devised. The district law will by that time have reached its highest degree of usefulness. Losses by percolation from canals and reservoirs will be prevented in so far as possible and steps will be taken to reduce the loss through evaporation. The volume unit will replace the unit expressing a continuous flow and the water user will pay toward the maintenance of the irrigation works which serve him in accordance with the supply he uses. Such refinements in administration are impossible and impracticable at the present time, but they must come with the settlement of the land and the growth of the community interest in the water supply.

While it may appear to us now that this future condition is a matter which concerns this generation but little, there are communities which must require assistance and direction which will enable them to adjust themselves to the requirements of this new era at a comparatively early date. This means that our laws governing the use of water must be broad, so that the administrative officers will have opportunity to assist each community in accordance with the stage of development it has reached. It is believed that Wyoming has kept abreast of the demands that have been made in this direction and the sentiment of the water user is strongly in favor of the State maintaining this position.

The State should lead in all things that are aimed to assist the irrigator. The operation of the United States Reclamation Act, the Carey Act, and the district law relate to the construction, financial, and business phases of irrigation development, rather than to the administration. The State must be responsible for the laws enacted governing the use of water and for the administration of those laws which apply alike to irrigation enterprises, whether built by individuals, communities, under the Carey Act, or by the Federal Government.

With all the advance in ideas and reforms in administration the irrigator is still sorely in need of some investigation by the inventor and the scientific genius.

Flowing water has not yet been studied with sufficient care and enough work has not been done on water meters to enable the layman to make measurements which are in any degree satisfactory. Our ditches and canals are not naturally suited to weir measurements. This leaves us the measuring flume, which must be rated by the use of the current meter. What is needed is a simple meter that will record or indicate by a dial the velocity of water without the necessity of computations of any kind. The ditch rider and the water commissioner provided with such an instrument could, by providing measuring boxes, perform all of their own work and satisfy the water user at all times as to the volume of water delivered through any ditch. While the current meter now in use is so complicated that the layman can not understand clearly the relation between the velocity of the flowing water and the results obtained by reference to the rating table, and it instills some confidence in those who do not understand its complications, there is a growing demand for simple and effective machines which can be used by any intelligent man. Water measurements are becoming so important and the men engaged in the work are so numerous that some instrument should be designed which will enable them to obtain results of stream and ditch discharge in as direct a manner as can be conceived.

Irrigators now have to depend upon their own experience and upon the experience of neighbors to determine when certain crops need irrigation and how they can best be irrigated. They have but little data as to the final saving brought about by grading lands to be irrigated. These questions, together with the problem of locating permanent laterals, are matters of business. The stockman, the miner, and the specialist in many agricultural pursuits have obtained help from some public source when problems too far reaching for the individual have arisen. Only within the past few years has the farmer of this section been able to profit from a scientific study of irrigation from an agricultural standpoint. It is known that the volume of water applied and the time of the application have an important influence on vegetable life. This influence varies with every crop raised, so that the field for study is a broad one and it is important that detailed investigations of the subject be begun at an early date, for accurate information is essential to the farmer who is to attain the greatest measure of success, and reliable data can not be obtained from measurements made during one, two, or even five years.



LIST OF PUBLICATIONS OF THE OFFICE OF EXPERIMENT STATIONS ON IRRIGATION—Continued.

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- Bul. 138. Irrigation in Field and Garden. By E. J. Wickson. Pp. 40.
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CIRCULARS.

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- Circ. 67. Investigations of Irrigation Practice in Oregon. By A. P. Stover. Pp. 30.

SEPARATES.

- *Rise and Future of Irrigation in the United States. By Elwood Mead, Expert in Charge of Irrigation Investigations, Office of Experiment Stations. Pp. 591-612. (Reprint from Yearbook, 1899.)
- *Some Typical Reservoirs in the Rocky Mountain States. By Elwood Mead, Chief of Irrigation Investigations, Office of Experiment Stations. Pp. 415-430. (Reprint from Yearbook, 1901.)
- *Preparing Land for Irrigation. By R. P. Teele. Pp. 239-250. (Reprint from Yearbook, 1903.)
- *Potato Culture near Greeley, Colo. By J. Max Clark. Pp. 311-322. (Reprint from Yearbook, 1904.)
- The Relation of Irrigation to Dry Farming. By Elwood Mead, Chief of Irrigation and Drainage Investigations, Office of Experiment Stations. Pp. 423-438. (Reprint from Yearbook, 1905.)
- *The Scope and Purpose of the Irrigation Investigations of the Office of Experiment Stations. By Elwood Mead, Irrigation Expert in Charge. Pp. 317-327. (Reprint from Annual Report of Office of Experiment Stations for 1901.)
- Review of Irrigation Investigations for 1902. By Elwood Mead, Chief of Irrigation Investigations, Office of Experiment Stations. Pp. 359-385. (Reprint from Annual Report of Office of Experiment Stations for 1902.)
- Review of Irrigation Investigations for 1903. By Elwood Mead, Chief of Irrigation Investigations, Office of Experiment Stations. Pp. 469-502. (Reprint from Annual Report of Office of Experiment Stations for 1903.)
- Report of Irrigation and Drainage Investigations, 1904. By Elwood Mead, Chief. Pp. 425-472. (Reprint from Annual Report of Office of Experiment Stations for 1904.)

